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GENERAL SCIENCE.—*Our scientific "nervous system."* JOSEPH W. STILL, Doylestown, Pa.

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The problem of scientific communication is the most fundamental social problem of a scientific-technical society such as ours. This is so because the scientific communication system (in the broadest sense) is the "nervous system" of such a society. The "nervous system" of society like that of the living organism provides the means whereby the different "organs" (agencies) and "cells" (individuals) are coordinated and maintained in that harmonious relationship necessary for organized life. The analogy of scientific communication to a human nervous system is sufficiently useful to be worth detailing.

Our laboratories and scientists doing basic research are the "sense organs" of society. They are feeling, seeing, hearing; in a word, "sensing" the nature in which we live, in order to gain ever new information about that nature. Since the world and its nature are in a continuous state of change, it is necessary that these "sense organs" be as ever alert as our own sense organs if we are to stay "in touch" with the world and the nature in which we live.

The information obtained by our peripheral "sense organs"—the basic research laboratories—is reported in the form of written scientific papers. These are equivalent to the "sensory messages" which our own nerve endings are constantly sending to our brains. These messages from the research laboratories are transmitted by way of scientific journals (the equivalent of nerve fibers) to the libraries ("social brains") where they are stored ("memorized") and retained for future use.

Turning to the motor, the useful, side of the nervous system, we see that "social memory" provides the means whereby scientific messages are memorized and retained, sometimes over centuries of time, waiting to be coordinated with new messages in order to provide a basis for new ideas leading to new developments. Social usefulness (motor activity) in this analogy is represented by new inventions, which may either be physical or scientific inventions or simply new ways of performing various services in our society. Of course, since such changes modify the nature of the society in which we live, the circle is thus completed and the need for *continuous* study by *all* kinds of scientific sense organs is thus made apparent.

This anatomical analogy seems useful because it does two things: First, it provides a rather clear and vivid distinction between basic and applied (or developmental) research. Basic research is primarily interested in gathering information, while applied research is primarily concerned with using it. Second, the analogy lays stress on the organizational aspect of scientific communication as a total integrated system. Even though it is ultimately necessary, from an operational standpoint, to fragment the system we should always think about and deal with the parts in terms of the whole if we wish to maintain the functional integrity and vitality of the whole system. In fact we must have some kind of national coordinating agency if we want to have a first class scientific "nervous system." I shall not even trouble to repeat

the widely reported evidence that by comparison with the Soviet "nervous system" ours is not first class at present. Our failure to make any substantial progress toward fundamental solution of this problem, stems from the fact that we have no individual or agency responsible for the overall health and function of the entire "nervous system". The many "organs" which have a financial or bureaucratic stake in some aspect of this over-all problem seem each to be checkmating each other so that essentially nothing is happening.

It can be said unequivocally that our scientific communications have been constantly deteriorating relative to our needs for a number of years and that nothing has happened since Sputnik I to change this trend. In order to demonstrate this relative deterioration, it will be useful to consider briefly the history of written communication and of libraries.

The earliest evidences of written communication are the drawings of people, animals and objects found in caves throughout the world. In the evolution of language, these realistic drawings were eventually reduced to abstract symbols which formed the basis for hieroglyphics. In turn, hieroglyphics were finally replaced by still more abstract alphabets. These have proven to be the most flexible set of symbols invented up to the present time with which to construct words and convey ideas. The oldest written documents known were carved on stone and clay tablets as the Ten Commandments supposedly were and so possessed some mobility as compared with the cave drawings. Papyrus and animal skins and metal plates were developed still later and replaced the cumbersome early stone and clay slabs.

The oldest library was apparently the one established in Nineveh by the Assyro-Babylonian king Assurbanipal (668–626 B.C.). He assembled much of the "literature" then extant. This library was sufficiently large to require special catalogues for indexing the records contained in it. The library contained deeds, documents and letters, religious texts, historical accounts and a wide variety of works relating to various areas of art and science.

The first Greek libraries seem to have been organized during the lives of Plato and Aristotle.

The great Alexandrian library, which aspired to collect all the worlds literature was begun in 283 B.C. and was destroyed by fire in 47 B.C.

Undoubtedly the earliest libraries were simply repositories for storing in safety public records such as deeds, contracts, laws and so on. Then legends and historical accounts began to be saved. The earliest recording and storing of what might be called scientific data was apparently carried out by the ancient priest-astrologers who charted and recorded the position of the stars and planets. It was through the accumulation and later analysis of such data that it became possible for scholars to discover that the heavenly bodies were not in a state of permanent rest as once thought.

The problems of those early libraries must have been largely physical problems; problems of duplicating material without error, a feat which we know was seldom accomplished; problems of handling documents without causing severe physical damage to the text and so on. Because these books were written in long scrolls the matter of frequent rolling and unrolling would soon wear them out. Finally the problem of storing papyri in ways that would protect them from weather, insects, and rodents must have been a difficult one. We have seen that the recently discovered Dead Sea Scrolls were stored in earthenware jars. Though the number of documents may have been relatively small, still the space problem must have been considerable. Of course, since these early libraries were intended to serve only a tiny fraction of the total population, the demands made on them were much less than today.

Modern libraries face much more complex problems, those of classification, storage, and retrieval of millions of items for large numbers of users. These modern library problems really begin with the invention of printing at the beginning of the Renaissance. Thus modern experimental science, which also dates from the Renais-

sance, and the modern science library are essentially the same age. The development of these two areas is so completely interconnected, as the "nervous system" analogy indicated, that we cannot usefully consider one without the other.

The analysis which I shall present in the following paragraphs shows that (whereas laboratory science and research has changed functionally from a static to a dynamic phase, our library system has remained at the earlier static phase of development. As a result, these two parts of the "nervous system" are now out of phase. Because of this, our science libraries have to a considerable extent already ceased to perform their full role as the retained and useful memory of our scientific knowledge. As a result of this breakdown, other make-shift though inadequate substitutes are being improvised to fill the communication deficit. Only by thoroughly reorganizing our science communication network to meet the dynamic needs of modern dynamic science, can we bring these two aspects of modern science into harmony. The present improvised make-shift solutions which generally add to the complexity of our "nervous system" will in the long run further damage our science communication system. So we should hasten to make the fundamental changes necessary to reorganize on dynamic lines. What are the changes needed to provide ourselves with a dynamic "nervous system"? How can we make these changes? But before we deal with the operational questions there are several general policy matters that must first be stated, as the remainder of the suggestions in this paper can only be carried out if these basic policies are first accepted and implemented. Stated affirmatively these policies are:

1. *Scientific communication is the "nervous system" of our society! As such it is the most important system in our social organization*, for we can not even maintain let alone improve our technical society without it. One only need consider the chaos that results when a bus or streetcar strike occurs, or when there is a power failure for a few hours, to see how utterly dependent we are on technology to maintain our way of life in modern cities and industrialized society. If our scientific communication were to really break down completely, as eventually it will surely do if really adequate corrective measures are not soon taken, we would ultimately find our cities degenerating for lack of trained personnel into chaotic jungles with "frozen" transportation and communication networks. One can easily imagine that such communities would be incapable of controlling the disease which would then break out to destroy the human life within them.

2. We do not have any national agency responsible for watching after the integrity of our "nervous system" as, for example, the Federal Reserve Board watches the integrity and vitality of our banking system. *We must establish a National Library and Communication Commission to perform this function.* If our banking system which is a vastly simpler system requires a full time Board to study and regulate its operations so do these far more complex matters require similar guidance.

3. Like many problems in this world, no absolute 100 percent perfect solution is going to be offered here or elsewhere. *We must cease waiting for a perfect solution to be discovered and begin taking active common sense steps toward finding a solution now.* As we take those common sense steps and observe results the way ahead will become clearer.

This is not the time to enter into extended arguments to support these affirmations. They are the basic assumptions on which the following suggestions rest.

The first point to recognize in approaching the operational aspect of this problem is that there are fundamentally two kinds of basic scientific information, (1) that which deals with essentially static data and (2) that which deals with essentially dynamic data. These two kinds of data are quite distinct. Static information is descriptive and/or classificatory in nature. Looking at the history of all well-developed sciences today, we observe that the static phase always precedes the dynamic and we also see that this phase must be fairly well developed before a science is ready for the dynamic phase; the phase in which relationships operating in time become the

focus of interest. To illustrate this point, we note that anatomical descriptions preceded physiology, and natural history descriptions and classification systems for plants and animals preceded the dynamic theory of evolution. It is this historical point which provides the key for understanding our library crisis. Most of our present libraries were organized in earlier times to serve static needs, the storage of public records, historical accounts and so on. The static organization of these libraries was also adequate to the needs of early static science. Hence, the general libraries were simply expanded to meet new scientific needs. But as science has grown dynamic, this static library organization has grown less and less adequate, until now we are nearing the point of total breakdown. I say we are nearing the point of total breakdown, because the time has arrived when it is being found cheaper to repeat some experiments than to spend the time required to search for the earlier ones in the literature.

There is one library on this continent (maybe the only one in the world) which is an exception to what has just been said. This one library is organized on dynamic lines. It is the library of Dr. Hans Selye, at the Institute of Experimental Medicine and Surgery in Montreal, which is devoted to the task of identifying and storing all scientific data relative to endocrinology and stress. It was the discovery of Dr. Selye's unique library organization a few years ago which provided me the clue I have used in developing the greatly expanded science communication scheme which I am about to present. My exploratory research made at that time in order to prepare a research request looking toward a deeper exploration of his system convinced me of the uniqueness of his system.

The basis of the Selye classification scheme is the clear recognition that every experiment involves the study of the action of a stimulus on a target. Selye symbolizes this as $T \leftarrow S$. Targets and stimuli with which his library deals are restricted to those of interest to the endocrine-stress field. But the dynamic $T \leftarrow S$ symbol system is obviously one which is applicable to all dynamic experiments. In fact the $T \leftarrow S$ symbol really corresponds to a cybernetic "bit" of information. The simplicity of the system derives from the fact that it always strives to reduce the data which it codes to the smallest possible "bits" contained in the reports being coded.

How can a classification scheme be built up from such symbols? Dr. Selye has established a set of codes and rules of precedence for targets and stimuli. The system makes a distinction between stressors and stimuli, but for our purposes I will ignore this and refer to all such agents as Stimuli. His rules of precedence are essentially as arbitrary as those of the Dewey decimal system and we need not be concerned with the details. They are as arbitrary as deciding that as doctors describe the different parts of the body they must always proceed from head to foot. Selye's rules are only useful in assigning a definite position in the classification scheme to various $T \leftarrow S$ relationships, and possess no other logical relationships. The rules are not extensive. If they are forgotten, they can easily be looked up. The codes are chiefly abbreviations of the standard names of Targets and Stimuli.

To clarify this general description, let me describe the system at work. Selye's library receives several hundred journals which contain essentially all reports of research in the endocrine-stress field. Each article is read and all reported $T \leftarrow S$ relationships are identified and coded. For example an experiment which studied the affect of cold on the adrenal glands would be coded, *Adr.* ← *Cold*. Since Adrenal has a definite assigned position in the order of precedence for targets, and since cold also has a definite position in the order of precedence of stimuli there is therefore a unique position in the classification scheme for the relationship *Adr.* ← *Cold*. So with a reasonably small number of targets and stimuli it is possible to identify and classify all such relationships in this rather large field of science.

Selye's system then gives an accession number not to every journal received, but to every article which is of interest to the library. So far as possible, individual re-

prints of articles are maintained rather than the intact journals themselves.

As already mentioned all of the $T \leftarrow S$ relationships identified in each article are coded and indexed. A file card exists for every $T \leftarrow S$ relationship which has been identified by the system. This card is to be found filed in the unique position defined by the rules of precedence. When the coding of an article is completed, clerks pull all the pertinent $T \leftarrow S$ cards from the file and the accession number of the new article is added to each of them and the $T \leftarrow S$ file cards are returned to their proper file position. The reprint of the article itself is placed in its accession number position. A separate author file, cross-referenced with accession numbers, is also maintained, but this is really not essential for the operation of the system, for retrieval is ordinarily accomplished by reference to the $T \leftarrow S$ file. From time to time, new $T \leftarrow S$ relationships are identified and when they are new cards are prepared and usually the unique place in the classification scheme in which it will be filed has already been defined by the Rules of Precedence. If a new target or stimulus develops or if an old target or stimulus needs to be subdivided it is a simple matter to add to or amend the Rules of Precedence or add a new or subdivide a few old $T \leftarrow S$ cards accordingly. Thus the classification scheme is easily updated to include the expanded more rational subdivision of information.

From the standpoint of retrieval, the system is remarkable because when one wishes to determine what studies have been made concerning a particular $T \leftarrow S$ relationship, one only has to encode that relationship, look at the appropriate $T \leftarrow S$ card and call for the references listed thereon to get everything in the library which has already been recognized, at the time of original accession, to have dealt with that relationship. Dr. Selye estimates that the system is close to 95 percent perfect. That is, every important $T \leftarrow S$ relationship in their library has been identified, coded, and listed on the $T \leftarrow S$ cards. It is easy to imagine what benefit such a system is to Dr. Selye and his colleagues. It reminds me of the advantage of putting and keeping your shirts in one place as compared with having to hunt them each morning as if you were hunting Easter eggs.

The laborious, tedious, time-consuming searches for bibliographical data as each new question arises, which the average researcher must undertake, is simply unnecessary with this system.

Now the question is: Can this system serve as a model for solving the communication problem of science in general? The answer is Yes! There are four main aspects of the matter to be considered:

(1) Our existing set up, inefficient as it is, can not be dispensed with until the new system is ready to take over.

(2) A single communication organization representing all aspects of science would need to be organized to plan and guide the reorganization. Needless to say, it would have to have authority and great prestige to accomplish the task in hand.

(3) The principle steps in the actual reorganization would be these—

(*a*) Develop a universal scientific code based on the $T \leftarrow S$ principle. Though no attempt will be made here to develop such a code it will merely be pointed out that in the physical sciences Targets are usually material objects and they may therefore be naturally classified according to size ranging from sub-atomic particles upward. The stimuli being forces, also have a natural classification system. (Some may object to these statements concerning the nature of targets and stimuli especially as they might apply at the atomic nuclear level where transformations from Mass to Energy and vice versa may occur. Perhaps the statements will prove too sweeping, and thus show that the $T \leftarrow S$ scheme as I have outlined it will not fit all possible situations in the physical sciences. I am not competent to argue the matter at the nuclear level. I know of no clearcut exceptions to these statements, so I will let them stand as at least first approximations, subject to modification if proven necessary. I don't claim to have a perfect solution, only a better one.)

(*b*) Dividing the science library problem into a number of practical working

units each of a size similar to the one which Dr. Selye already has in operation. Arranging this division so no unwanted overlaps between library units existed. Arranging for coordination of code expansions so that areas of overlap would so far as possible have identical codes for any single $T \leftarrow S$ relationship. The national science library would thus consist of a number of geographically decentralized operating units set up as adjuncts of working laboratories, which would be welded into a single system by means of the central planning organization. The detailed codes would not need to be centrally worked out. Only general rules of coordination would need to be laid down to govern their peripheral development.

(*c*) As the decentralized libraries became operational it would be possible for most existing library systems to stop handling scientific journal reports and ultimately they would even be able to discard most of their existing files of bound journals. This change-over might be possible on a gradual basis, but it is difficult to be sure until the actual organizational problems have been met in practice. When the dynamic libraries were fully operating this would leave existing nonresearch libraries storing only static information including monographs, atlases, textbooks, etc. and being served by the dynamic library system for their other science needs.

(4) The actual operation of the system would involve the following steps:

(*a*) Master subject file—Theoretically headings for all possible $T \leftarrow S$ relationships could be made out and filed according to the rules of precedence of targets and stimuli. Then every piece of research dealing with a given $T \leftarrow S$ relationship would be filed behind its heading card in chronological sequence. One variation from Selye's setup would be important. Instead of maintaining articles by accession number as Selye does, each article should be microfilmed and a Mini-card made for each $T \leftarrow S$ relationship identified by the coders. These cards would be filed behind the appropriate $T \leftarrow S$ heading cards in the master subject file in chronological order. Even on a world basis it should be possible to place every new report in such a file within thirty days of publication.

(*b*) Once the Mini-cards had been coded, punched, and verified and the actual article microfilmed on it, it would be simple to duplicate such cards as often as necessary. (The master cards might be of metal or plastic to increase their permanence.)

(*c*) Probably the actual master subject file cards can be fed directly into machines (existing ones or types that could be developed) and the contained information printed for bibliographies, etc. Thus, a research worker could ask for and quickly receive a complete bibliography on any $T \leftarrow S$ relationship. Of course, the complete cards could be duplicated and sent out as well, thus furnishing the individual scientist with all reported scientific data pertaining to a particular $T \leftarrow S$ relationship.

(5) *Further extensions and advantages of such a system*—It can readily be foreseen that such a system would have a number of logical extensions, uses and advantages which have not yet been mentioned. Some of these are:

(*a*) Annual statistical studies of new entries into the subject file would be of considerable value to those interested in administrative and planning aspects of science.

(*b*) Although $T \leftarrow S$ heading cards might only be made for those in which some research had actually been reported, it can easily be seen that the mere mechanical listing of all clearly defined $T \leftarrow S$ possibilities *not yet studied* could have value in pointing to neglected research areas.

(*c*) By using microfilm or Mini-card technics, articles could be duplicated as many times as necessary and filed in pertinent $T \leftarrow S$ positions in the master subject file. If stored and filed by Mini-card technic, no serious problem develops from library growth and the resulting need to interfile new materials. (In contrast to Mini-card, the maintenance of such reports on microfilm rolls would be much more complicated from an administrative standpoint.)

(*d*) Once the system was fully operational there would be no need for binding and retaining journals as is currently done. The Master Library System would keep the master file and distribute duplicates to working libraries and individual sci-

entists which would thus have complete libraries in the special areas of $T \leftarrow S$ interest.

(*e*) The actual content of journals would ultimately be greatly effected by the system. Probably most research—especially that concerning negative results—would no longer be published in complete journal form. Instead, journals would deal mostly with short abstracts of really new basic findings, interpretive and theoretical articles and the like. The wasteful procedure of publishing thousands of copies of data of current interest to only a handful of people would be stopped. This limited interest data would be furnished to such a library system where it could be coded and photographed like any other article and be available to interested investigators when requested. Arrangements would exist so that workers interested in any $T \leftarrow S$ field to which new data was added would automatically be sent duplicate copies of Mini-cards. This would provide an automatic "express" of all new data to the researchers working in that area.

(*f*) Ultimately, the coding of articles might be decentralized to the journals themselves so the coders could benefit by direct communication with the author concerned.

(*g*) Such a classification system would make possible the ready identification of all workers in a specific $T \leftarrow S$ classification, thus facilitating the organization of symposia when desired. Reviews, monographs and textbooks written with such a library system in support could be approximately current instead of several years out of date when printed. The present method of static filing would be adequate for these latter types of publication, but the information contained in them would be more current than is presently possible.

(*h*) From time to time, committees could examine the literature under various $T \leftarrow S$ categories and could relegate, with suitable comments, to historical files such experiments as had been found to be outdated or erroneous. If this seemed undesirable they could at least append some kind of warning note to such data. This would save new entrants to such fields from being misled or wasting time on data of dubious validity. Of course, such a system of classification and filing would facilitate the association of "retractions" with the original article when an author might later find reason to wish to retract some statement.

This plan is built on a basis corresponding to the ways in which the human mind organizes its knowledge. It does not promise to be 100 percent perfect, as do the electronic pigeonhole systems on which so much energy has been spent with very limited results to date. (A detailed criticism of the many fruitless efforts in this general direction, was written by Dr. Yehoshua Bar-Hillel in 1957 and published in *American Documentation* **8:** 103–113.) The system offered here only promises the degree of perfection which a well-informed and well-trained human intellect may give, perhaps in the neighborhood of 90 percent on short-range matters, less on long-range. However, the system is extremely flexible and its errors are easily correctible. It is therefore perfectible. Thus the longer the system works the better it should get. This would appear to be a system which will serve science far into the future.

ETHNOGEOGRAPHY.—*Pile-dwellers and coconut culture in the Laguna de Sinamaica, Venezuela*,[1] RAYMOND E. CRIST, University of Florida. (Communicated by Paul H. Oehser.)

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Many urban agglomerations are located where they are because of a favorable site and propitious economic factors. But in many parts of the world there exist villages that have as bases factors which, to the person brought up on Western economics, are noneconomic or antieconomic; villages that have been founded in response to their founders' desire to be cut off from the world rather than to be in easy contact with it.

One such village settlement, only some 30 miles north of metropolitan Maracaibo, consists of groups of pile-dwellings in the shallow waters of the estuary of the Limón River, known locally as the Laguna de Sinamaica. Here the visitor rides in a motorboat through a village that has many similarities to the settlements of Neolithic man in the lakes of Switzerland.

In 1498 the northeast corner of South America was discovered by Columbus on his third voyage to the New World. The following year, Alonso de Ojeda, a Spanish conquistador, on a voyage of exploration sailed into the Gulf of Venezuela and Lake Maracaibo, which Columbus had not visited. He found along the east shore native houses built on stilts over the waters of the lake, and this prompted him to call the sector Venezuela (little Venice). This picturesque name gradually came to be used to denote all that part of South America that in time became the Republic of Venezuela.

Certain of these settlements of pile-dwellings still exist as low rent areas for workers in Maracaibo: e.g., in Santa Rosa, a northern suburb of metropolitan Maracaibo, as well as in the village of El Moján, 15 miles north of Maracaibo near the mouth of the Río Limón. These houses, all in the shallow water near shore, are inhabited for the most part by heads of families who earn their livelihood by working on shore, usually in Maracaibo. However, the inhabitants of the agglomerations of pile-dwellings up the Limón River earn their livings and live out their lives in homes under which there is always a sheet of water. Sometimes during low water it is possible to wade to a neighbor's house, but most of the travel is done by dugout canoes that are paddled with great dexterity. Produce of all kinds, including pigs and chickens, is transported in dugouts in the settlement itself, and contact with the outside world is made by sailboats or boats with outboard motors.

These settlements in the Laguna de Sinamaica were probably first established by Parajauno Indians as they sought safety from the fierce warriors of the Guajiro tribes coming from the north. The Parajauno language is still spoken by a large number of these lake-dwellers, who were perhaps too weak in numbers or in energy to seek a better abode, but who, however, with the years have found their site increasingly advantageous.

The whole group of stilt-dwellings, referred to as the settlement in the Laguna de Sinamaica, is made up of three distinct agglomerations, called La Boca del Caño, La Boquita, and El Barro. They are located at the upper end of the estuary of the Río Limón, about 20 kilometers upstream from the ferry-crossing at Puerto Mara and some 40 kilometers downstream from Carrasquero. La Boca del Cano, the largest settlement, is located where the Limón itself empties into the estuary. La Boquita is situated at the point where the largest distributary of the Limón enters the estuary. El Barro is a collection of houses in very shallow water out in the brackish-water

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estuary, or laguna, itself, usually a mud-flat at low tide, as its name implies.

The settlement was probably originally established on the natural levees of the river and its distributaries, and the first two of the settlements named are more or less linear in type. As space on land became limited, more and more houses were built on stilts, and the original compactness has been lost. El Barro is a typical *caserío,* i.e., it is like thousands of tiny rural settlements in Latin America, neither rural village nor typical dispersed settlement. The church is new, built on an artificial island instead of on piles, and is a testimony to the energy of the Capuchin missionaries.

The original settlers almost certainly had fishing as their main activity. A surplus of the catch could be exchanged for the food products grown by those living on land. The waters of the estuary still abound in fish, and fishing continues to be an important occupation. Fishermen are to be seen almost any time of the day paying out or hauling in their nets, and the festoons of nets drying in front of the houses are one of the most picturesque features of this unique village. The daily bread, or starch ration of a goodly part of the population was then as now the *plátano,* or cooking banana.

It is not known just when coconut trees were first planted in this sector, or how long it took before their economic importance was appreciated. Old residents of Sinamaica felt pretty sure that coconuts came into prominence about a hundred years ago. At all events, the introduction of the coconut palm gave a new orientation to the economy of these lake-dwellers. The precarious self-sufficiency of former days gave way to an economy tied to the Maracaibo market, by the sale of coconuts and their byproducts.

Coconut trees were first planted on the natural levees along the distributaries of the streams flowing into the estuary, but little by little the area suitable for growing trees and other crops has been increased by the Herculean efforts of man. Artificial islands are created by building a tight fence of stout posts enclosing in the beginning just a plot of water. The enclosure is gradually filled in with reeds, earth, or about any kind of refuse that comes to hand, till the surface of the entire space enclosed by the fence is above the level of the water at high tide. Even before the plot has become solid ground in its entirety young palm trees will be set out. While waiting for them to mature the land is not allowed to remain idle, but is planted in cooking bananas for home use. A few stocks of sugar cane may also be grown, the fermented juice of which (*guarapo*) is a favorite and refreshing beverage. These artificial plots belong of course to the person or persons who create them and they are inherited by their children. They can also be sold, but such cases are rare, as those brought up in the settlement like it there and hold on to their hard-won property. When such plots are sold they are almost invariably bought by someone living nearby in the settlement.

There is a limited sale of coconuts in the unripe stage when they contain the largest amount of delicious *agua de coco,* used as a refreshing drink, alone, or mixed with rum. These green coconuts are taken down river where they find a ready sale at the ferry-crossing at Puerto Mara. By far the largest part of the crop, however, is harvested when ripe. Barefooted boys or men climb the trunks with great agility and with deft strokes of their machetes cut down the heavy clusters of coconuts. The big fruits are then transported in dugout canoes to the house where they are husked. After this process—all done by hand, of course—the extremely hard inner shell is cracked open, and the white meat is removed and ground on a primitive grinding machine, consisting usually of a wheel to which perforated strips of tin have been attached. Oil is pressed from these ground coconut meats, and the coconut cake and whey after the oil has been removed are used to feed the hogs kept in a narrow pen beside the oil presses. Thus the process of making coconut oil has hogs on the hoof and pork and lard as byproducts, all of which are in short supply and hence find a ready market in Maracaibo.

Prices in Venezuela, and especially in

FIG. 1.—Dug-out canoes equipped with sails ply between the highway and the stilt village.

FIG. 2.—Fishing is an important industry. These young men are laying out a seine.

FIG. 3.—Drying fish nets.

FIG. 4.—The artificial island to the right already has grown coconut palm trees on it. The island to the extreme left is in process of being built.

FIG. 3.—Drying fish nets.

FIG. 4.—The artificial island to the right already has grown coconut palm trees on it. The island to the extreme left is in process of being built.

FIG. 5.—A recently constructed island with sugarcane, young coconut palms, and one banana plant.

FIG. 6.—A canoe load of rushes to be used as material for making walls of houses and in the making of sleeping mats.

FIG. 7.—Roofing a house with palm leaf thatch.

FIG. 8.—Canoe loads of coconuts from which oil is extracted.

FIG. 10.—Clothes are washed at the water's edge in the shade of a convenient coconut palm.

FIG. 12.—The mayor's house has a porch on it, packed with flowers.

FIG. 9.—Oil is squeezed out of the ground coconut meats by hand and the oil cake is fed to the hogs kept in the pen to the left.

FIG. 11.—Everyone learns to paddle a canoe. This woman is going calling on her nearest neighbor.

Maracaibo, are so inflated that even exact figures as to prices received for produce give only an approximation of the real income of those who live in the Laguna. About the best one can do is to contrast the level of housing in the Laguna with that in Maracaibo. Further, no one seems to work exclusively at one task and thus be dependent upon one source of income. Those who worked rather steadily at making coconut oil and fattening hogs averaged slightly more than unskilled laborers in Maracaibo and more, even, than some of the lower echelon white-collar workers. But this does not take into account the perquisites of living and working in the Laguna.

The pile-dwellings are more spacious and comfortable by far than the huts in the slums of Maracaibo. Further, the womenfolk add a considerable amount to the family income by gathering reeds and making them into sleeping mats.

A house socially acceptable in this community is built in a few days, in a bee in which neighbors and friends of the family take part. All the material used is locally grown: poles for uprights, flooring of palm planks, walls of rushes (*enea*) or palm leaves, roofs of palm thatch. A well-made roof lasts for six or seven years before it must be replaced, so upkeep is hardly a worry.

The home is not merely a place in which to retire to eat and sleep and to keep out of inclement weather, as are in general the houses of poorer people, built on dry land, throughout tropical Latin America. Dwellings on piles are lived in 24 hours of the day, especially by women and children. Small children are in the house at all times, since there are no playgrounds. The doorways of some of the more unpretentious houses have slats across them to prevent infants from tumbling into the water. At an early age lake-dwellers become adept at paddling a canoe, but the grownups have first call on using the family canoe—there are no two-canoe families. Houses are simple constructions, almost barren of furniture. There seems to be complete resignation to, or even satisfaction with, what many outsiders would consider minimum comfort. In many homes the housewife may do a great deal of sewing, or several members of the family may be engaged in the making of reed sleeping mats, a major household industry; yet even such a simple and essential item as a chair may be most uncomfortable, or indeed entirely absent!

The four men who have acquired small boats equipped with outboard motors, with which they transport coconuts to Puerto Mara where they pick up groceries and notions—and even an occasional sightseer—enjoy what in larger communities would certainly be called middle-class status; at all events they definitely outrank those who own only small canoes for use in paddling about the settlement or even those who have canoes large enough to accommodate a small sail and which are used to transport produce.

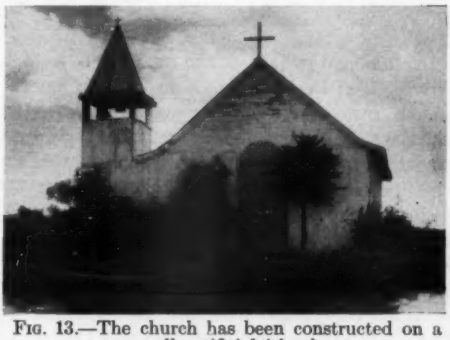


FIG. 13.—The church has been constructed on a small artificial island.

The *raison d' etre* of these settlements cannot of course be the same in 1958 as it was when they were founded. But in spite of the inconveniences inherent in the site and in spite of the tremendous pull of the labor market in Maracaibo with all its modern attractions, these lake settlements continue not only to thrive but to grow. And it certainly is not merely a question of inertia. Other urban agglomerations, even on more favorable sites, have become ghost towns, losing population to the cities with fewer economic attractions than Maracaibo. Are these people still imbued with the sense of inferiority and inadequacy that caused their forebears to settle there in the first place? That would seem highly unlikely. It would seem more probable that these people

are wise enough to realize that the advantages of living in dwellings on pilings at a distance from Maracaibo still outweigh the advantages offered for people with their skills and economic capacities by Maracaibo. They find it preferable to live where they are, under conditions that they know, rather than to move and thus run the risk of living in a metropolitan slum. They can build in a few days a house that is adequate and socially acceptable, and thereby avoid paying rent. Their village is already provided with such modern items as a school, a church, telephone connections with the outside world, electric lights, canned foods and bottled drinks—items and services that for the most part are due to the money economy made possible by the introduction of the coconut palm. Perhaps the money economy was the *sine qua non* that made it possible for the inhabitants of the Laguna to take a new lease on life; without the introduction of the coconut palm the lake-dwellers might have felt called upon to migrate, to try for a higher level of living elsewhere, as do so many of the descendants of the once-fierce Guajiro Indian warriors, whose attacks probably made lake-dwellers of the peace loving Parajauno Indians in the first place.

JUNGLE CAMOUFLAGE

A mammal whose fur is a garden is the *Bradypus* of Barro Colorado Island, the Smithsonian Institution's jungle wildlife preserve in the Canal Zone. The creature is better known as the three-toed sloth—to Panamanian natives as the "perezoso." It is, in superficial appearance at least, one of the least active of warm-blooded animals, moves slowly and infrequently, and may spend as much as 18 hours of each day in apparently deep sleep.

Along the jungle paths of the Canal Zone Biological Area, as the 4,000-acre island of dense rain forest is officially known, the *Bradypus* is one of the more numerous mammals. Quite likely, however, it will go unnoticed, mistaken for a mossy excrescence or perhaps a termite nest, as it clings upside down and probably fast asleep to some overhanging branch. This natural protection is due to one of the most unusual camouflage devices in nature. The coarse, brownish hairs of its fur are full of minute cracks. In these cracks grow unique species of algae, one-celled plants. These give the animal a grayish-green hue, which helps it to blend with its environment. Thus the sloth is not likely to be bothered by predatory mammals or by the birds of prey that swoop low over the rain forests. This is a give-and-take arrangement. The particular species of alga is ideally adapted to grow and flourish in the cracks of the sloth's hair and nowhere else.

Much the same is true of the two-toed sloth, close relative of the *Bradypus*, not as slow, and somewhat larger. In this species the coarse hairs are grooved and thus provide secure beds for the algae of species related to those found in *Bradypus*.

The sloths are sometimes further protected in their slumbers by the fact that the trees they frequent are often also homes of red fire ants, which, for some unknown reason, never bother them. They attack viciously most other warm-blooded animals and are among the terrors of the jungle.

ZOOLOGY.—*The cutaneous muscles of the Adelie penguin* (Pygosceles adeliae). L. R. SETTY, School of Medicine, Howard University. (Communicated by Herbert Friedmann.)

(Received November 17, 1958)

The material used in this account of the cutaneous muscles of the Adelie penguin (*Pygosceles adeliae*) was taken from one specimen that died in the zoo at Portland, Oreg. The cutaneous musculature of one specimen of the emperor penguin (*Aptenodytes fosteri*) from the same zoo was also examined.

The cutaneous muscles remained attached to the underside of the removed skin. Because of this fact, the muscles were studied and figured from their medial surfaces (Fig. 1). They were observed both when they were in the fresh state and later when they were preserved in a solution made of equal parts of 4-percent formaldehyde, glycerine, and 95-percent alcohol.

The only description to be found in the literature available, on cutaneous muscles of penguins was that in *Report on the anatomy of the Spheniscidae* by Dr. Morrison Watson (Zool. Voy. *Challenger*, pt.

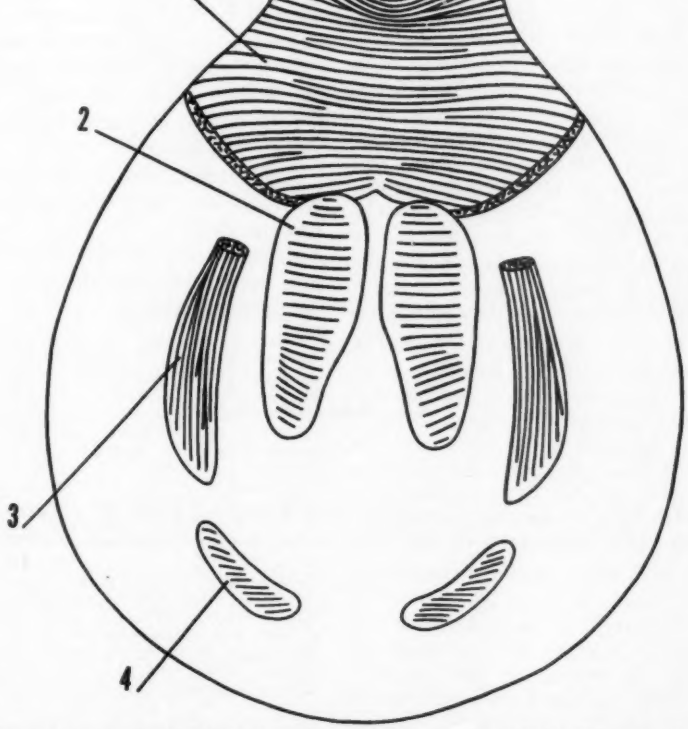


FIG. 1.—The cutaneous muscles of the Adelie penguin (*Pygoceles adeliae*). These muscles are shown from their underside and *in situ* in the removed skin. 1, Panniculus carnosus; 2, cutaneous dorsalis; 3, abdominis superior; 4, abdominis inferior.

18. 1883). Watson described and figured the cutaneous muscles for *Eudyptes chrysome*, and he observed these muscles in *Eudyptes chrysolophus*, *Aptenodytes longirostris*, *Spheniscus magellanicus*, *Spheniscus minor*, and *Pygosceles taeniatus*. He stated that the system of cutaneous muscles is developed to a greater extent in penguins than in any other bird, with the exception of *Apteryx*. He added that this development is probably related to their aquatic habits and the necessity of an arrangement whereby the water may be readily expelled from the interstices of their furlike plumage.

The cutaneous muscles of *Pygosceles adeliae* (Fig. 1) are as follows:

1. *Panniculus carnosus*: A very extensive muscle extending over the whole cervical region. Its origin is from the upper border of the clavicle. Many of its fibers are inserted on the cranium just back of the orbit, and many of its fibers extend to the middorsal line of the neck, where they blend with the corresponding fibers of the opposite side.

2. *Cutaneus dorsalis*: An elongated muscle on the dorsal side of the cephalic end of the trunk. Most of the fibers run transversely to its long axis. Its cephalic half is wider than its caudal half. In *Aptenodytes fosteri* the two halves of cutaneus dorsalis are essentially of the same width.

Watson stated that in the two specimens of *Pygosceles taeniatus* he dissected this muscle was entirely wanting. But this muscle is quite conspicuous in *Pygosceles adeliae*.

3. *Abdominis superior:* An elongated muscle on the lateral side of the trunk. Its fibers run approximately parallel to the long axis of the body. At its cephalic end it attaches to the tendon of insertion of pectoralis major.

4. *Abdominis inferior:* An elongated muscle but only about half as long as abdominis superior. It is situated caudad of abdominis superior. Most of its fibers run obliquely.

In *Pygosceles adeliae* a distance of about 1 inch intervenes between abdominis inferior and abdominis superior. But in *Aptenodytes fosteri* the cephalic end of abdominis inferior makes contact with the caudal end of abdominis superior.

The names abdominis superior and abdominis inferior are here used for the first time in the nomenclature of cutaneous muscles of penguins. Watson considered (for the species studied by him) the muscles here so named as parts of a muscle termed muscle des parures.

A fifth cutaneous muscle, called constrictor colli, has been described by Watson. But its fibers are very intimately blended with those of panniculus carnosus. Therefore it is here considered as a part of panniculus carnosus.

By Nature's kindly disposition most questions which it is beyond a man's power to answer do not occur to him at all.—GEORGE SANTAYANA.

ENTOMOLOGY.—*Revalidation of three species of* Armigeres *Theobald, 1901 (Diptera: Culicidae).*[1] ERNESTINE B. THURMAN.[2]

(Received November 18, 1958)

The need to evaluate the status of four species of mosquitoes in the subgenus *Armigeres* in relationship to the type species of the genus, *Armigeres obturbans* (Walker, 1860), became evident during a study of the specimens of the genus in the collection of the U. S. National Museum in connection with a revisionary treatment of the Culicidae of northern Thailand. *Armigeres joloensis* (Ludlow, 1904), *Armigeres kuchingensis* Edwards, 1915, and *Armigeres durhami* Edwards, 1917, are hereby revalidated to specific rank, and *Armigeres subalbatus* (Coquillett, 1898) is applied to the common Oriental species distributed from Japan, China, and Taiwan south and west through Thailand to India and Ceylon.

A. joloensis was described from specimens captured at Jolo Jolo, Philippine Islands (May, 1903), as a variety of *Desvoidea fusca* Theobald, 1903, which is currently a synonym of *Armigeres malayi* Theobald, 1901. The lectotype male is in good condition in the U. S. National Museum.

Blanchard (1901) proposed the generic name *Desvoidya*, incorrectly assuming that *Armigeres* was preoccupied by *Armiger* Hartmann, 1840–1842 (Mollusca). Theobald (1910) considered *Desvoidya joloensis* as a valid species. In 1913 Edwards placed the species in the genus *Armigeres*, revalidating the name and stating that it was not preoccupied by *Armiger* Hartmann, thus it antedated *Desvoidya* Blanchard, 1901 (misspelled *Desvoidea* by Theobald, 1903). Later Edwards (1915) stated that he was in error in 1913 when he synonymized *Armigeres jugraensis* (Leicester, 1908), under *A. joloensis* and that the latter represented only a slight color variation of *A. obturbans*. *A. joloensis* is listed as a synonym of *A. obturbans* by Edwards (1932) and Bohart (1945).

A. kuchingensis was described from two males and six females collected by Edwards, July 24–27, 1914 (females biting), at Kuching Reservoir, Sarawak. In 1917, Edwards described *A. durhami* from Bukit Kutu, Malay Peninsula, as "much as in *kuchingensis* . . . clasper with distinct swelling on the flexor surface a little beyond middle." Three specimens of *A. durhami* collected by Dr. Durham were named as *Desvoidya fusca* by Theobald (1903). Barraud (1927) placed *A. durhami* as a variety of *A. kuchingensis* along with three varieties from India which he described in the same paper (var. *nongpohensis*, var. *shillongensis*, and var. *dibrugarhensis*). Later Barraud (1934) synonymized these varieties as only individual variations of *A. kuchingensis*. Borel (1930) listed *A. durhami* as a synonym of *A. kuchingensis*, while Bohart (1945) listed *A. kuchingensis* as a synonym of *A. obturbans*.

The type of *A. obturbans*, a female collected on Makassar, Celebes, by Wallace, has been lost; the type of *Culex ventralis* Walker, 1861 (questioned as a synonym of *A. obturbans* by Edwards, 1932), a female collected in Amboyna (Amboina, Moluccas) by Wallace, is not in a condition to be of scientific value (Mattingly in personal communication to Stone, 1955). In 1865, Walker

[1] Scientific Article no. A695, Contribution No. 2917, of the Maryland Agricultural Experiment Station, Department of Entomology. Acknowledgment is made of the support provided by the National Institute of Allergy and Infectious Diseases, National Institutes of Health, Public Health Service, D. H. E. W., under Grant E 809 awarded to William E. Bickley, Department of Entomology, University of Maryland; and of the assistance rendered by the United States National Museum, Smithsonian Institution; the Entomology Research Division, U. S. D. A.; and the U. S. Operations Mission to Thailand, International Cooperation Administration. The author is indebted also to many persons who have assisted her with the various phases of her studies, particularly to Dr. Alan Stone, of the Entomology Research Division, U. S. D. A.; Peter F. Mattingly, of the British Museum; Dr. Donald L. Colless, of the University of Malaya; William W. Macdonald, of the Institute for Medical Research, Kuala Lumpur; Dr. William E. Bickley, of the University of Maryland; and Dr. Dale R. Lindsay, of the Public Health Service, D.H.E.W.

[2] Senior scientist (R), on detail from the Division of Research Grants, National Institutes of Health, Bethesda 14, Md., formerly assigned as malaria control adviser with the U. S. Operations Mission to Thailand, I. C. A.

described a species from New Guinea, which he named *Culex ventralis*, n. sp. This name is invalid as a primary homonym. The type is unknown. The character, as based on descriptions, distinguishing *C. obturbans*, *C. ventralis* of 1861, and *C. ventralis* of 1865, is the coloration of the apex of the hind femur. For *C. obturbans* the hind femur is described as white beneath; for *C. ventralis* of 1861, there is a purple tomentum, and for *C. ventralis* of 1865, the femur is silvery white with the apex dark. The holotype (female) of *Culex subalbatus*, which is a synonym of *A. obturbans* according to Edwards (1932) and Barraud (1934), is in very good condition in the U. S. National Museum.

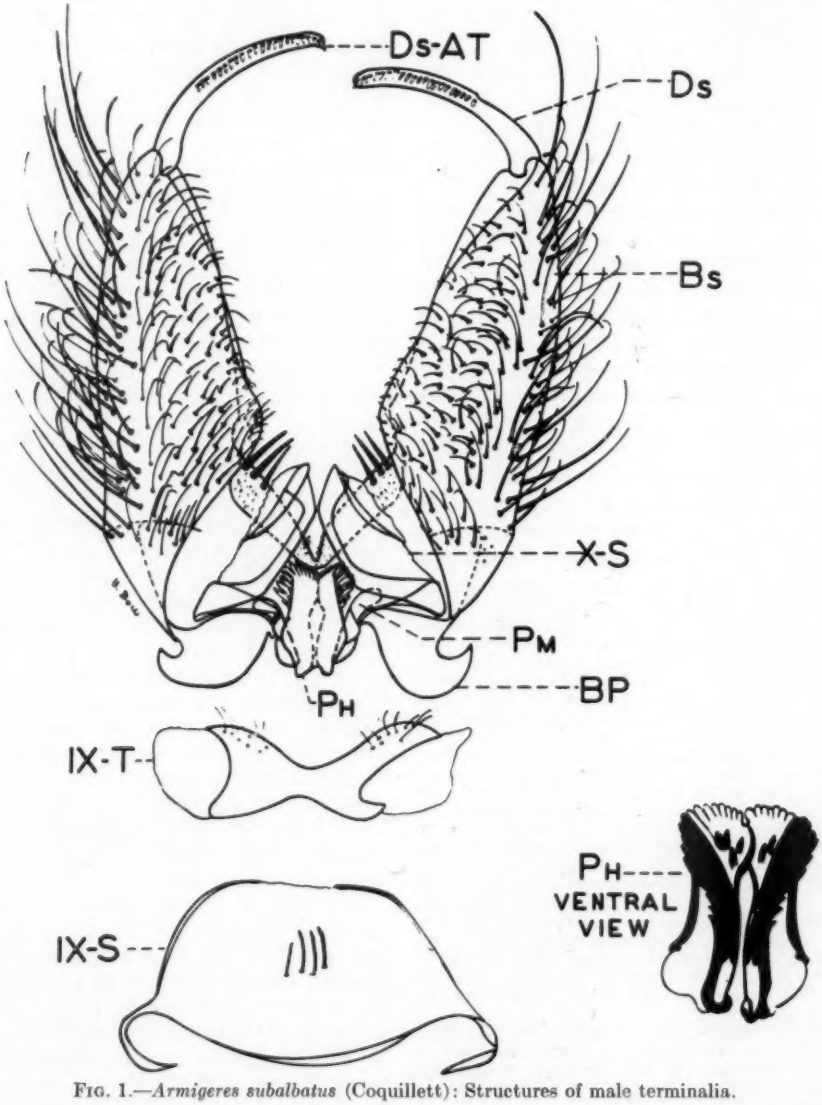


FIG. 1.—*Armigeres subalbatus* (Coquillett): Structures of male terminalia.

The apex of the hind femur of the holotype of *C. subalbatus* is white on the venter and the ventrolateral aspects.

Bohart considered the common Philippine *Armigeres* with a long dististyle in the male, to be *A. obturbans*. This common species Baisas (1935) called *A. kuchingensis*, though he figured a species with a short dististyle. Stone and E. Thurman (1958) have shown that Baisas was dealing with a species which in general habitus appears to be *A. kuchingensis* though there are significant differences in the structures of the claspette, phallosome, and dististyle. This

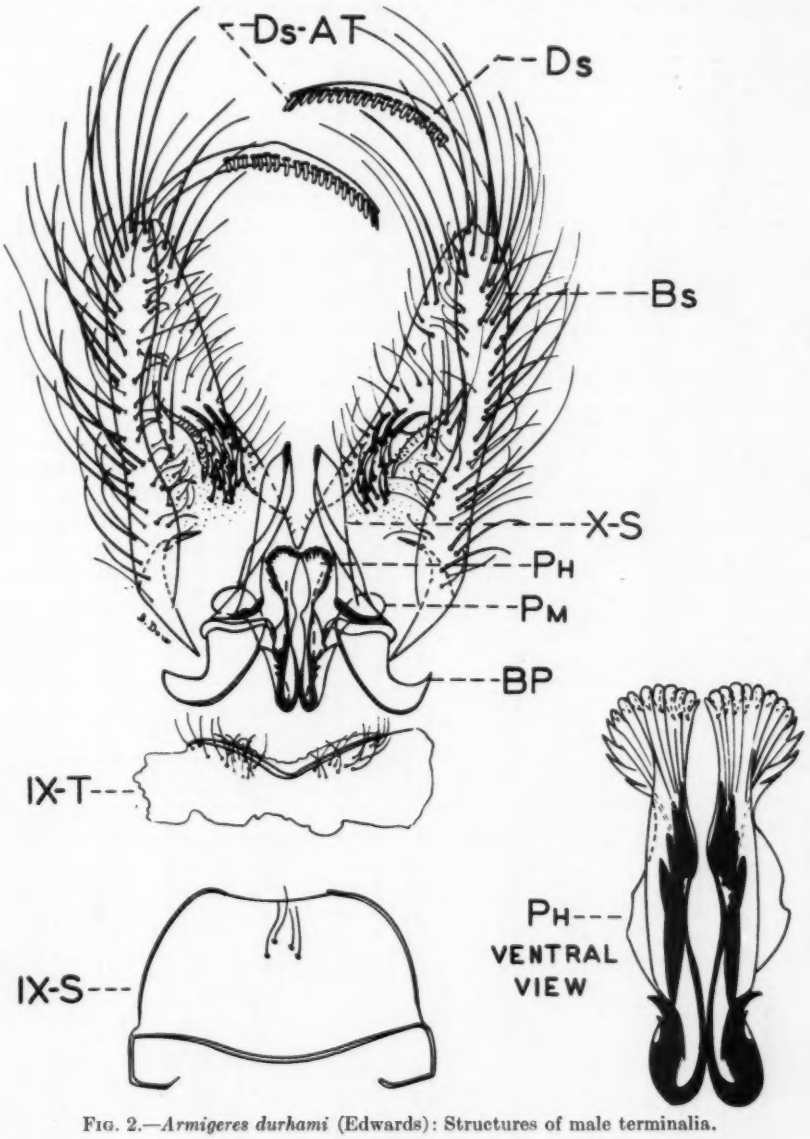


FIG. 2.—*Armigeres durhami* (Edwards): Structures of male terminalia.

TABLE 1.—DIAGNOSTIC CHARACTERS OF ADULTS OF SIX SPECIES OF ARMIGERES THEOBALD, 1901

Characters	*A. obturbans*? *A. ventralis*?	*A. subalbatus* (Fig. 1)	*A. joloensis**	*A. durhami* (Fig. 2)	*A. kuchingenesis**	*A. baisasi**
Female palpi/length proboscis	¼-⅓	⅓-¼	⅓-¼	⅓-¼	⅓-¼	⅓-¼
Mesonotal border	Creamy white	White	White	Indistinct, white	Usually distinct, white	Male wide, white; female narrow or lacking
Posterior pronotal lobe	White with narrow curved dark scales forming broad dorsal line beneath white border	White (few have bronzy or dark scales in dorsal patch)	White (rarely find few bronzy or dark scales in dorsal patch)	White in Indian and Thai specimens; with narrow golden or bronzy dorsal patch in Malayan specimen	White	White
Sternites III-VI	Apical dark bands decreasing in width (½ of III; ⅓ of IV; ¼ of V; ⅛ of VI)	Apical dark bands decreasing in width (½ of III; ⅓ of IV; ¼ of V; ⅛ of VI)	Usually narrow apical bands; may be as in *subalbatus*	Narrow, faint bronzy apical bands; or bands wider on III & IV than on V & VI	White	White
Sternite VII	Dark with subapical white band narrow	Dark with subapical white band narrow	As in *subalbatus;* some females with subapical band wide, medially scalloped nearly covering segment	Dark with narrow subapical white band	Dark with narrow subapical white band	Dark with apical white band
Lateral abdominal markings	White, triangular, rarely visible on dorsum	White, triangular, may be visible on dorsum	White, semicircular, not visible on dorsum	White, large, reaching well up on to dorsum	White, semicircular, visible on dorsum (?)	White, semicircular, not visible on dorsum
Fore coxa	White with medial dark spot	White with medial dark spot	Usually white; rarely with small bronzy spot	White with dark spot	Usually white; rarely with small bronzy spot	White
Hind femur	*obturbans:* white "underneath" *ventralis*, 1861: "purple tomentum" *ventralis*, 1865: "silvery white, apex dark"	White on sides and venter to apex (few with dark scales on ventrolateral aspects	White on sides and venter to apex	White on sides and venter to apex	White on sides and venter to apex	White on sides and venter to apex
Male midclaw	Unequal	Unequal	Equal	Equal	Equal	Equal
Male terminalia: Basistyle	2.5-3:1	2.5-3:1	2.5-3:1	2.5:1	3:1	3:1
Dististyle	Short, not reaching setae of claspette	Short, not reaching setae of claspette	Long, reaching base of setae of claspette	Long, reaching base of setae of claspette	Long, reaching base of setae of claspette	Short, not reaching setae of claspette
Setae of claspette	2-3, sharp, pointed away from basistyle	2-3, sharp, smooth, pointed away from basistyle	2-3, curved, spatulate at apex, striated	3-4, sharp apex, flattened, striated, curved toward basistyle	4-5, flattened, smooth, curved toward basistyle	2, sharp, pointed toward basistyle
Phallosome	Ventral lobe undivided, 5-7 lateral projections; minute points near middle on venter of dorsal lobe	Ventral lobe undivided, 5-7 lateral projections; minute points near middle on venter of dorsal lobe	Ventral lobe divided, 3 or 4 projections in basal portion	Ventral lobe divided, 2-3 small projections at base, 4-5 finger-like ones reaching nearly to apex of dorsal lobe	Ventral lobe divided, 2 small projections at base, 2 long ones reaching nearly to apex of dorsal lobe	Ventral lobe with V-shaped division, 4 or 5 graduated projections from base with sclerotized median process, small points near middle on venter of dorsal lobe

* Illustrations of the structures of the male terminalia of *A. joloensis*, *A. kuchingensis*, and *A. baisasi* are presented by Stone and E. Thurman (1958).

kuchingensis-like species with a short dististyle Stone and E. Thurman (1958) described as *Armigeres baisasi.*

After much deliberation the author has concluded that: *A. subalbatus* (Coquillett) and of Bohart (1945) represents the common Oriental species, which is the *A. obturbans* of Barraud (1934) *et auctorum* (*nec* Walker, 1860), in areas north and west of Malaya; *A. obturbans* of Bohart (1945) *et auctorum* reported from the Philippine Islands includes *A. joloensis* and *A. kuchingensis*, if the latter species occurs in the Philippine Islands; *A. kuchingensis* of Baisas (1935) is all or in part *A. baisasi*; and that *A. obturbans*, if the name is to be retained, should be applied to specimens from localities near or adjacent to its type locality inasmuch as the type is lost and the diagnosis of the species differs among specialists. The author prefers to consider *C. obturbans* and *C. ventralis* of 1861 and 1865 as *nomina dubia.*

Diagnostic characters of *A. obturbans, sensu stricto*, based on literature as well as specimens and unpublished notes from Colless, 1954–56, and Macdonald, 1957–58; of the holotype of *C. subalbatus*; of the lectotype of *A. joloensis*; of the holotype of *A. kuchingensis*; of *A. durhami*, based on Thai specimens and unpublished notes from Colless, 1954–56; and of the holotype of *A. baisasi* are presented in Table I. The structures of the male terminalia of *A. subalbatus* and *A. durhami* are illustrated in Figures 1 and 2. Illustrations of the structures of the male terminalia of *A. joloensis, A. kuchingensis*, and *A. baisasi* are presented by Stone and E. Thurman (1958).

REFERENCES

BAISAS, F. E. *Notes on the Philippine mosquitoes. I. The* Armigeres *group.* Philippine Journ. Sci. **56**(4): 485–497. 1935.

BARRAUD, P. J. *A revision of the culicine mosquitoes of India: Part XX, The Indian species of* Armigeres (*including* Leicesteria) *with descriptions of two new species.* Indian Journ. Med. Res. **14**(3): 533–548. 1927.

———. *The fauna of British India. Diptera* **5**: *Megarhinini and Culicini*, 463 pp. London, 1934.

BLANCHARD, R. *Observations sur quelques moustiques.* Compt. Rend. Soc. Biol. **53**: 1046. 1901.

BOHART, R. M. *A synopsis of the Philippine mosquitoes.* U. S. Nav. Med. 580: 48 pp. 1945.

BOREL, E. *Les moustiques de la Cochinchine et du Sud-Annam.* Soc. Pathol. Exotique. Monogr. **3**: 1–423. 1930.

EDWARDS, F. W. *New synonymy in oriental Culicidae.* Bull. Ent. Res. **4**: 221–242. 1913.

———. *Diagnoses of New Bornean Culicidae.* Bull. Ent. Res. **5**: 283–285. 1915.

———. *Notes on Culicidae, with descriptions of new species.* Bull. Ent. Res. **7**(3): 201–229. 1917.

———. *In* P. Wytsman, *Genera insectorum, Diptera, Fam. Culicidae:* 258 pp., 5 pls. 1932.

LUDLOW, C. S. *Mosquito notes.* Can. Ent. **36**: 233–236. 1904.

STONE, A., AND THURMAN, ERNESTINE B. Armigeres (Armigeres) baisasi, *a new mosquito from the Philippine Islands (Diptera: Culicidae).* Journ. Washington Acad. Sci. **48**(7): 240–243. 1958.

THEOBALD, F. V. *Monograph of Culicidae or mosquitoes.* **3**: 359 pp. London, 1903.

———. *Monograph of Culicidae or mosquitoes.* **5**: 646 pp. London, 1910.

WALKER, F. *Catalogue of the dipterous insects collected at Makassar in Celebes, by Mr. A. R. Wallace, with descriptions of new species.* Journ. Linn. Soc. London, Zool. **4**: 90–172. 1860.

———. *Catalogue of the dipterous insects collected in Amboyna by Mr. A. R. Wallace, with descriptions of new species.* Journ. Linn. Soc. London, Zool., **5**: 144–168. 1861.

———. *Descriptions of new species of the dipterous insects of New Guinea.* Journ. Linn. Soc. London, Zool., **8**: 102–130. 1865.

* Illustrations of the structures of the male terminalia of *A. joloensis, A. kuchingensis*, and *A. baisasi* are presented by Stone and E. Thurman (1958).

ZOOLOGY.—*Further remarks on the geographical distribution of Gorgoniidae.* FREDERICK M. BAYER, U. S. National Museum.

(Received November 17, 1958)

In my paper of 1953 on the zoogeography and evolution in the octocorallian family Gorgoniidae, I advanced the proposition that the closely related group of gorgoniid genera characterized by scaphoid spicules is an adaptive offshoot of the mainstream of gorgoniid development produced in response to altered environmental conditions resulting from cessation of interoceanic communication across the Isthmus of Panama toward the end of the Miocene time. One of the premises upon which this theory depends was that the "scaphoid genera" of gorgoniids are endemic in the Caribbean region. Except for *Pterogorgia peruana* Stiasny, said to be from Callao, and four species of *Pseudopterogorgia* from the East Indies and Australia, no species have been reported outside the West Indian area, and I disposed of these exceptions by considering *P. peruana* to be a West Indian species with incorrect locality data, and the species of *Pseudopterogorgia* to be species of *Leptogorgia* with somewhat bent spindles erroneously interpreted as scaphoids. I had seen neither *P. peruana* nor any *Pseudopterogorgia*, and the collections of gorgonians in the U.S. National Museum contained no "scaphoid species" from the west coast of the Americas nor from the East Indies.

During the course of studies conducted in European museums, made possible by the assistance of the Biology Branch of the Office of Naval Research through a program with the American Institute of Biological Sciences, I was able to examine part of Stiasny's type of *Pterogorgia peruana* and a specimen of *Pseudopterogorgia oppositipinna parvispiculata* Bielschowsky from Amboina, contained in the collections of the Rijksmuseum van Natuurlijke Historie at Leiden. Even though the locality datum of *P. peruana* is still open to question—the species has not turned up in subsequent collections from South America—it is certainly not identical with any of the known West Indian species; it agrees in most particulars with *Pseudoterogorgia australiensis* (Ridley). Moreover, the spicules of *Pseudopterogorgia*, as revealed by a specimen from Amboina, are without doubt genuine scaphoids and not bent spindles as the literature once led me to believe.

These observations mean that (1) "scaphoid species" of Gorgoniidae do occur in the Indo-Pacific; (2) "scaphoid genera" are not restricted to the Caribbean region and probably came into being while Atlantic-Pacific intercommunication still existed; and (3) the Indo-Pacific species of *Pseudopterogorgia* are generically inseparable from the West Indian *Pterogorgia*, a name that I replaced with *Antillogorgia* for reasons stated in 1951 (p. 97). The generic name *Pseudopterogorgia* obviously takes precedence over *Antillogorgia*, which is a junior subjective synonym.

I will now show by means of a few figures that the scaphoid spicules are not sufficiently different in Atlantic and Indo-Pacific species to warrant generic separation. In Fig. 1 is shown a typical scaphoid of *Gorgonia acerosa* Pallas, type species of *Antillogorgia*; in Fig. 2, a scaphoid typical of *Gorgonia americana* Gmelin; in Fig. 3, a blunt scaphoid characteristic of *Pterogorgia rigida* Bielschowsky; in Fig. 4, a blunt, undulated scaphoid of *Pterogorgia blanquillensis* Stiasny; in Fig. 5, a similar blunt, undulated scaphoid from *Pseudopterogorgia oppositipinna parvispiculata* Bielschowsky; in Fig. 6, a scaphoid of *Pterogorgia peruana* Stiasny; and in Fig. 7, an acute, strongly undulated scaphoid of *Pterogorgia bipinnata* Verrill.

It is quite clear that the only distinguishing characteristic of *Pseudopterogorgia*—the 2–4 belted scaphoids "deren zugespitzte Enden mit ähnlichen, nicht regelmässig angeordneten Warzen besetzt sind" (Kükenthal 1924, p. 355)—is found also in West Indian *Antillogorgia*. From this it is clear that the correct generic name for the plumose, scaphoid-bearing gorgoniids of both Atlantic and Indo-Pacific is **Pseudo-**

pterogorgia Kükenthal, 1919, with the following synonymy:

Gorgonia (part) Pallas, 1766, Elench. Zooph.: 160.
Pterogorgia (part) Ehrenberg, 1834, Abh. Akad. Wiss. Berlin 1832 (pt. 1): 368.
Pseudopterogorgia Kükenthal, 1919, Ergebn. Tiefsee-Exped. **13**(2): 854. [Type species, *Pseudopterogorgia australiensis* (Ridley), by original designation.]
Antillogorgia Bayer, 1951, Journ. Washington Acad. Sci. **41**: 97. [Type species, *Gorgonia acerosa* Pallas, by original designation.]

Diagnosis.—Plumose, pinnate gorgoniids with no trace of anastomosis of the branchlets. Cortical spicules predominately scaphoids in the outer layer and straight, belted spindles in the axial sheath. Anthocodial armature strong, weak, or absent, when present consisting of flat rods with scalloped edges.

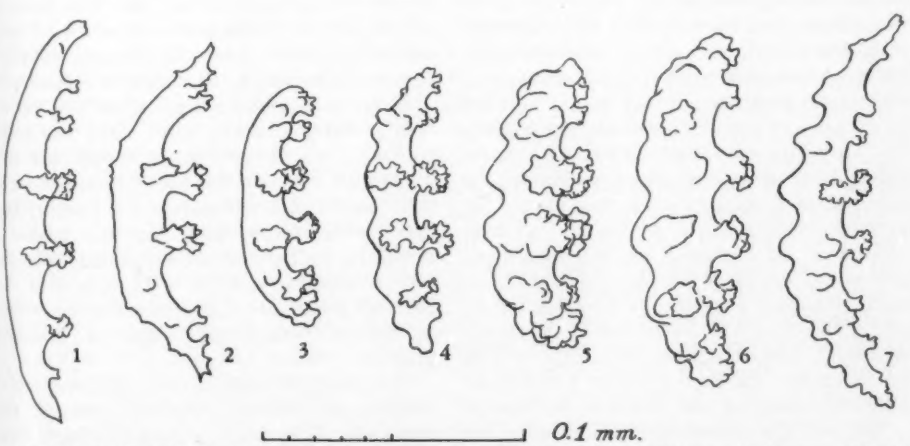
Remarks.—It will be noted in the seven figures given herewith that four of the scaphoids, those belonging to *bipinnata, blanquillensis, oppositipinna parvispiculata,* and *peruana,* are sculptured with broad, rounded ridges across the convex side, whereas such ridges are absent from the scaphoids of *acerosa, americana* and *rigida,* in which the ornamentation of the convex side is reduced to a few prickles or suppressed entirely. This character of smooth or slightly prickly scaphoids is shared by all Caribbean species of *Pseudopterogorgia* except *P. bipinnata* (Verrill), the closely related and perhaps identical *kallos* (Bielschowsky), and *blanquillensis* (Stiasny). Unfortunately, the examination of a large number of specimens of various species discloses intergradation between these scaphoid types. Occasionally, some of the blunt scaphoids of *P. rigida* have low ridges across the convex side, and in *P. blanquillensis* a few are practically smooth. It appears that all of these variations are simply progressive phases in the development of a trend begun with the unilaterally spinose spindles of *Leptogorgia.*

If the ornamentation of the convex side of the scaphoids is used as a basis for dividing *Pseudopterogorgia* into two subgenera, then the original zoogeographic proposition may retain some degree of validity since no species with smooth scaphoids has yet been discovered outside the West Indian region. The subgenus with ridged scaphoids, found chiefly in the Indo-Pacific, is represented in the Atlantic by two or three rather uncommon species.

For the convenience of those who may wish to extend recognition to these two groups of species, subgenera are defined for them as follows:

Genus **Pseudopterogorgia** Kükenthal, 1919
Subgenus **Pseudopterogorgia** Kükenthal, s.s.

Diagnosis.—The transverse girdles of tubercles on the scaphoids are developed across the



FIGS. 1–7.—Scaphoid spicules of *Pseudopterogorgia* species: 1, *Pseudopterogorgia acerosa* (Pallas); 2, *P. americana* (Gmelin); 3, *P. rigida* (Bielschowsky); 4, *P. blanquillensis* (Stiasny); 5, *P. oppositipinna parvispiculata* Bielschowsky; 6, *P. peruana* (Stiasny); 7, *P. bipinnata* (Verrill).

convex side of the sclerites as blunt, rounded ridges.

Distribution.—Four species and one subspecies in the East Indies, Philippine Islands and Australia; two, possibly three, in the tropical western Atlantic.

Subgenus **Antillogorgia** Bayer, 1951

Diagnosis.—Transverse girdles entirely suppressed on the convex side of the scaphoids, which may be completely smooth or somewhat prickly.

Distribution.—Nine species in the tropical western Atlantic.

REFERENCES

BAYER, FREDERICK M. *A revision of the nomenclature of the Gorgoniidae (Coelenterata: Octocorallia), with an illustrated key to the genera.* Journ. Washington. Acad. Sci. **41**(3): 91–102, 14 figs. 1951.

———. *Zoogeography and evolution in the octocorallian family Gorgoniidae.* Bull. Mar. Sci. Gulf and Caribbean **3**(2): 100–119, 5 figs. 1953.

EHRENBERG, C. G. *Beiträge zur physiologischen Kenntniss der Corallenthiere im allgemeinen, und besonders des rothen Meeres, nebst einem Versuche zur physiologischen Systematik derselben.* Abh. Akad. Wiss. Berlin 1832 (pt. 1): 225–380. 1834.

KÜKENTHAL, WILLY. *Gorgonaria.* Wiss. Ergebn. deutschen Tiefsee-Exped. **13**(2): 1–946, 318 figs., pls. 30–89. 1919.

———. *Gorgonaria.* Das Tierreich **47**: xxviii + 478 pp, 209 figs. Berlin, 1924.

PALLAS, PETER SIMON. *Elenchus zoophytorum:* xvi + 28 + 451 pp. Hagae-Comitum, 1766.

RIDLEY, STUART O. *Alcyonaria.* Rep. Zool. Coll. H. M. S. *Alert*: 327–365, pls. 36–38. 1884.

———. *Report on the alcyoniid and gorgoniid Alcyonaria of the Mergui Archipelago, collected for the trustees of the Indian Museum, Calcutta, by Dr. John Anderson, F.R.S.* Journ. Linn. Soc. London, Zool., **21**: 223–247, pls. 17–18. 1888.

STIASNY, GUSTAV. *Alcyonides et gorgonides des collections du Muséum National d'Histoire Naturelle.* Mém. Mus. Nat. Hist. Nat. Paris, nouv. sér., Zool., **3**(1): 1–80, pls. 1–22. 1951.

HITCH-HIKERS OF THE SEA

There are sea hitch-hikers.

This group of curious fishes—the remoras, or disk-fishes, which ride about attached to other marine animals by disks that act like suction cups—is being subjected to a specialized study by Dr. E. A. Lachner, associate curator of fishes of the Smithsonian Institution. These remoras, tropical and semitropical and found around the world, have been the subject of much legendry throughout history. In early 16th-century woodcut maps they were pictured as "ship stoppers," with grotesque groups of four or five attached to the hulls of ships and holding them motionless. They were considered responsible for the so-called dead calms sometimes encountered by sailing ships. Even now their ways of life and the evolution of their curious suction disks are little understood. Dr. Lachner is asking fishermen and others who may encounter them to send him as many details as possible—the hitch-hiker itself and a photograph or description of the species of animal to which it is attached. He is making an exhaustive search of literature for as many accounts, anecdotal and otherwise, as possible.

The remoras become hitch-hikers when but very tiny creatures. At this size they are sometimes referred to as "louse fishes," perhaps because they resemble lice in their habit of creeping into the gill chambers of such fishes as the barracuda, the manta ray, or the sailfish. Some remoras reach a length of 3 feet and ride about on giant sharks, sea bass, and other large hosts. Others appear to be quite selective in their choice of transportation. Dr. Lachner is especially interested in this aspect of their life. One remora is found only on marine mammals, as whales and porpoises. Another species, for example, will ride only on the swordfish, the sailfish, or the marlin.

So far as known the remoras do not injure their probably unwitting hosts. Their only purpose seems to be to get rides, although when the whole story is known this may turn out to be a much more complex procedure, Dr. Lachner believes. Some authors think they may render a service by feeding on minute organisms that infest the hosts. It is likely, he believes, that the hitch-hiker rides to localities which are their own as well as their hosts' feeding or breeding grounds.

The young have clusters of exceptionally large, hooked, and backward-directed teeth on the lower jaw. These may be used to secure their holds on their hosts before the suction cup becomes fully developed. The suction disk is an

evolutionary development of the spiny dorsal fin, behind the head. It is very large in comparison with the size of the fish, and in one species its length is nearly half that of the body length. When the remora is about half an inch long the disk is behind the head, weak and nonfunctional. As body growth continues, the disk develops powerful muscles and also actually assumes a forward position over the head.

Different species can be distinguished by the structure of these disks, which are provided with numerous lamella or folds, powerful muscles, and spiny denticles to aid in clinging to the host. The species also differ in the size and development of the fins, in having different dentitions, in characteristic numbers of vertebrae, and in their body coloration. The remoras, Dr. Lachner points out, apparently are parasitic only in their hitchhiking. They never have lost their own ability as rapid swimmers in pursuit of their prey—but it is easier to ride than swim. Some species, he says, such as the whale suckerfish, are very rare and have been reported only a few times in American waters.

VOICES OF THE STARS

The stars seem to have voices. These constitute an important phenomenon of the new radio astronomy which is producing a strikingly different picture of the heavens. The so-called "thermal noises," which differ markedly from source to source, are described by Dr. Gerald S. Hawkins, director of Boston University Observatory, in a report recently published by the Smithsonian Institution. Says Dr. Hawkins: "The sun and local galaxy can be heard as a gentle hiss," the galactic noise remains steady but the storms on the sun swell and fade many times in the course of an hour. Jupiter is the performer that really dominates the air. When heard over a high-fidelity system, its roars and rumbles almost convince one that the Romans were right in their ideas about the gods."

The signals tell us about various heavenly bodies, for the most part invisible in the most powerful telescopes. Much also is learned about clearly visible objects—such, for example, as the sun. At wavelengths measured in centimeters, Dr. Hawkins says, the sun looks very much the same as it does to the eye, except that the steady light now is unaffected by cloud, rain, or fog. "At wavelengths of 20 centimeters, the sun ceases to be uniformly bright but develops a ringlike halo. Viewed with radio eyes it would appear as a brilliant circle with a dusky center. This is caused by the temperature inversion in the corona [the white halo seen around the sun at times of total eclipse whose temperature is many times greater than that of the solar surface] where the temperature increases as we move out from the sun. Looking at the center we see the cooler layers below, and looking at the limb we see the hotter layers edge-on. In addition to the limb brightening, star-like points appear on the disc of the sun.... It has been shown that these points occur near the visual sunspots, so at 20 centimeters the radio astronomer has a completely reversed image, a dark sun with bright sunspots."

Three types of major radio disturbances, the report points out, are recognized as emanating from the sun. These are "noise storms, outbursts, and bursts. A noise storm originates in a cloud in the corona, vertically above a sunspot. The cloud is invisible optically, but on radio wavelengths it shows temperatures of billions of degrees.... During periods of sunspot activity," says the report, "noise storms occur once every five days on the average. If the sun were to behave in the visible spectrum as it does at radio wavelengths the world would have been burnt to a cinder long ago. "One of the most spectacular phenomena is the noise outburst which occurs after a solar flare. The flare is usually accompanied by an upward surge of hot gas which leaves the chromosphere with a velocity of about 100 kilometers per second and then falls back again into the sun. An intense radio source, associated with the surge, moves outward with a velocity of the order of 2,000 kilometers per second. This movement has been followed in a number of surges ... and there is evidence that the radio source does not fall back again but leaves the sun completely as a corpuscular stream of electrons and positive ions. As the stream forces its way through the ionized layers in the corona it is able to emit radiation of increasing wavelength.... After a time lapse of about 24 hours the corpuscular stream reaches the earth and excites the atmosphere to make it glow with the beautiful colors and forms of the aurora."

ZOOLOGY.—*A new cyclopoid copepod,* Hemicyclops visendus, *associated with* Upogebia *in Madagascar.*

ARTHUR G. HUMES, ROGER F. CRESSEY, and RICHARD U. GOODING,[1] Boston University.

(Received November 11, 1958)

The specimens of the new clausidiid copepod described below were obtained by washing in 5 percent alcohol in filtered sea water more than 100 mud shrimps dug from their burrows in hard, intertidal mud at Nossi-Bé, Madagascar. We are indebted to Dr. Fenner A. Chace, Jr., for the identification of the shrimps as *Upogebia* (*Upogebia*) sp. (Crustacea, Anomura). Specimens of these have been deposited in the United States National Museum. We also wish to thank Dr. Jan H. Stock, who has allowed us to include certain unpublished material.

The field work was made possible by a John Simon Guggenheim Memorial Foundation Fellowship awarded the first author. Subsequent laboratory study has been aided by a grant from the National Science Foundation.

All figures were drawn with the aid of a camera lucida. The letters after each figure refer to the scale at which the figure was drawn.

Hemicyclops Boeck, 1873

Hemicyclops visendus, n. sp.

Specimens studied.—37 females, 17 males, and several immature specimens washed from the body surface of *Upogebia* (*Upogebia*) sp. at Pointe à la Fièvre, Nossi-Bé, Madagascar, June 13, 1955. Holotype female, allotype, and 13 paratypes (10 females and 3 males) deposited in the Institut de Recherche Scientifique de Madagascar at Tananarive, the same number of paratypes in the United States National Museum, and the remaining paratypes in the authors' collection.

Female.—Body length 1.87 mm (1.82–1.96 mm), width 0.74 mm (0.74–0.77 mm), based on 10 specimens. Anterior part of the body, including the fifth pedigerous segment, about 1.3 times longer than the posterior part, including the genital segment, abdomen, and caudal rami (Fig. 1). Terga of the second, third, and fourth pedigerous segments distinct with subacute posterolateral angles. First pedigerous segment fused with the head region, and the fifth narrow and not produced posterolaterally. Genital segment (Fig. 2) elongate, 360 x 266 μ, with a pair of long, low dorsolateral ridges and an indistinct transverse anterior furrow on its ventral surface, and having a striated, membranous posterior border. Egg sac attachments located on the extreme anterior corners. Abdomen (Fig. 2) 3-segmented, the segments 182, 120, and 90 μ in length, respectively, the first two with a striated, membranous posterior edge, the last with a posterior ventral row of spinules on either side of the midline. Caudal ramus (Fig. 3) about 1.7 times longer than wide, 120 x 70 μ, with the 6 setae, beginning with the innermost and slightly dorsal seta, 126, 210, 804, 492, 98, and 64 μ, respectively. Outermost two setae composed of a proximal half with the usual degree of sclerotization and a setuliform distal half, the junction between these as shown in Fig. 4. Inner margin of the ramus with a row of hairs. Outer margin with a minute hair near the base.

Egg sac (Fig. 1) somewhat variable in length, averaging about 270 x 125 μ, reaching to the posterior edge of the genital segment (or in some specimens almost to the beginning of the second abdominal segment) and containing many small eggs.

First antenna (Fig. 5) with 7 podomeres, their lengths being 57, 82, 61, 108, 44, 52, and 51 μ, respectively. An aesthetask on each of the last three podomeres. Certain setae with long, erect lateral hairs on the second, fifth, sixth, and seventh podomeres as shown in the figure. Very short lateral hairs on many of the remaining setae. Second antenna (Fig. 6) with 4 podomeres, the first elongate with groups of spinules and a long plumose seta on its inner distal angle; the second somewhat shorter with a group of slender spinules on its inner edge and a finely barbed seta on its inner distal angle; the third with a double row of long spinules on its inner edge and a row of small spinules along its slightly expanded outer edge,

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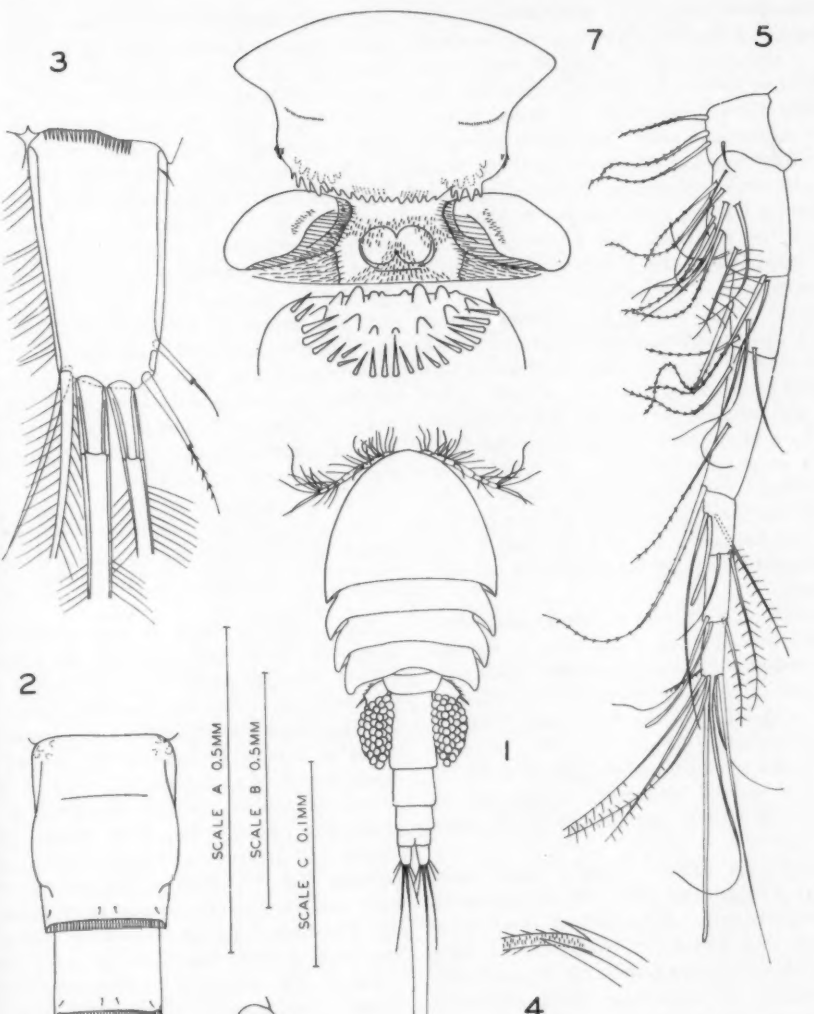


FIGS. 1–7.—*Hemicyclops visendus*, n. sp., female: 1, Dorsal view (A); 2, genital segment and abdomen, ventral (B); 3, caudal ramus, ventral (C); 4, detail of midregion of next to outermost seta of caudal ramus (D); 5, first antenna (E); 6, second antenna (E); 7, labrum, paragnaths, and labium bordering the oral region, ventral (C).

the inner distal angle of the podomere extended and bearing a small seta with a setuliform distal half, a prominent seta having its basal two-thirds armed with a row of 8 long spinules and its distal third filamentous and finely barbed, and 2 subterminal setae; the fourth podomere nearly quadrangular, offset on the third, bearing on its outer surface 2 comb-rows of spinules, and having 7 setae, 2 subterminal on the outer edge of the podomere and 5 terminal, 4 of these being linear, the fifth arising separately and having long lateral barbules.

Labrum (Fig. 7) with its posterior margin straight and composed of a median piece with 2 rows of teeth one above the other and a pair of lateral areas also with 2 rows of teeth. Other teeth and spinules as in the figure. Labium (Fig. 7) a broad area bearing 2 rows of teeth and an arcuate row of spines, all directed forward toward the mouth region. Between the labrum and the labium a bilobed area covered with very fine hairs. On each side just behind the paragnaths a triangular raised area also with fine hairs.

Mandible (Fig. 8) with a strongly sclerotized, elongate base bearing terminally a strongly sclerotized piece, a weaker spinulose blade having a row of toothlike spines on one side and a row of spinules on the other, and 2 barbed setae. Paragnath (Fig. 7) 78 x 38 μ, situated close to the mandible and consisting of an oblong ridge covered with hairs, bearing the relation to the labrum and the labium as shown in the figure.

First maxilla (Fig. 9) with 2 distal lobes, one with 5 setae (4 of them with strong lateral spinules), the other lobe with a stout spine provided with 2 rows of spinules, and with 2 setae. A rounded projection on the inner side of the base of the appendage. Small spinules as shown in the figure.

Second maxilla (Fig. 10) composed of 2 podomeres, the first large and having at its inner distal angle 2 large, coarsely spinulose setae, one with its broadened base bearing an accessory seta. The second podomere smaller, not inflated, with its distal end forming a strong spine (without an articulation) bearing on its outer edge 2 strong accessory spines and distally a row of 3 or 4 smaller spines. Near the base of this large spine a seta with a broad, stalklike basal half and a slender, recurved distal half, the junction between the two halves showing 3 spinules. Subterminally on the podomere an outer seta with lateral hairs and a stout inner spine with an apparently bifid tip and having a double row of long spinules along the middle of its outer edge.

Maxilliped (Fig. 11) with 4 podomeres, the first two elongate and both bearing the usual 2 setae, the last 2 podomeres very short. Third podomere with a single outer seta. Last podomere with a strong recurved inner spine having 4 or 5 slender spinules along its concave edge, a shorter spine with an inner row of spinules on its inner edge, and with an accessory seta arising on its base, and 2 long setae and 3 spinules as shown in the figure.

Swimming legs with trimerous rami. Connecting piece between the first pair of legs with a row of long hairs, but in legs 2–4 a double row of spinules in this position. Armature of the rami of legs 1–4 as follows:

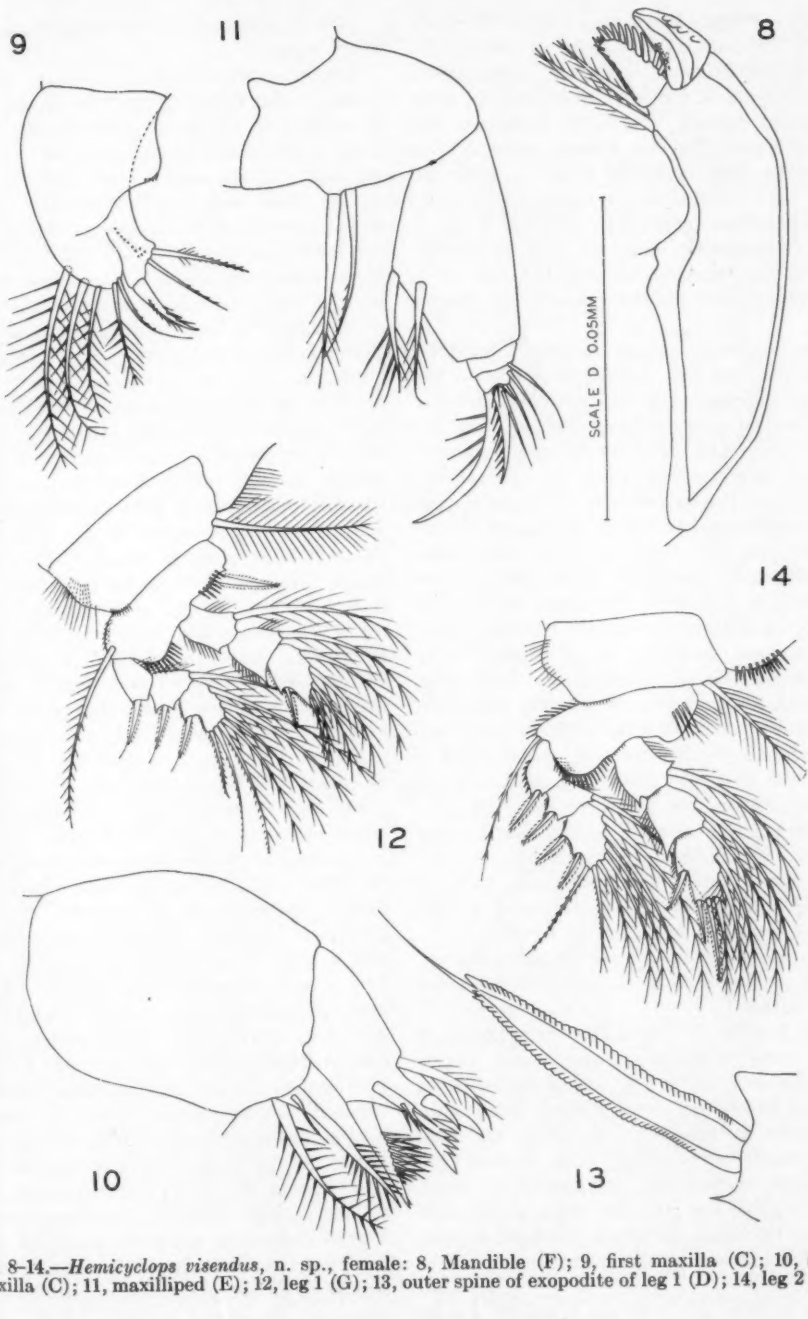
	leg 1		*leg 2*		*leg 3*		*leg 4*	
	exp	end	exp	end	exp	end	exp	end
1st podomere	1:0	0:1	1:0	0:1	1:0	0:1	1:0	0:1
2d podomere	1:1	0:1	1:1	0:2	1:1	0:2	1:1	0:2
3d podomere	8	6	9	6	9	6	8	5

Leg 1 (Fig. 12) with an inner spine on the basipodite. First three spines of the exopodite with a terminal setule (Fig. 13). Leg 2 (Fig. 14) with the basipodite extended laterad (a condition seen also in legs 3 and 4) and with a row of hairs on its inner margin instead of a spine. Leg 3 (Fig. 15) similar to leg 2. Leg 4 (Fig. 16) having the last podomere of the endopodite provided with three fringed spines, a seta half plumose and half fringed, and a plumose seta. The base of the next to outermost seta on the last exopodite podomere of legs 2–4 with 2–4 long inner hairs. Other ornamentation of the legs as shown in the figures.

Leg 5 (Fig. 17) with 2 podomeres, the first roughly quadrangular, about 100 μ long, with 2 groups of long spinules and an outer seta 125 μ long. Second podomere oval, 151 x 96 μ, having the ratio of 1.54:1, with 2 fringed spines inserted on the outer edge of the distal half, 63 and 54 μ long respectively, a naked seta 97 μ long arising from a small terminal papilla, and an inner fringed spine 67 μ long. Rows of spinules along the outer and inner edges of the podomere and near the bases of the outer spines as indicated in the figure.

Leg 6 absent.

Color in life under magnification in reflected light showing red speckling on the cephalothorax, eye red, egg sacs bright red.



FIGS. 8–14.—*Hemicyclops visendus*, n. sp., female: 8, Mandible (F); 9, first maxilla (C); 10, second maxilla (C); 11, maxilliped (E); 12, leg 1 (G); 13, outer spine of exopodite of leg 1 (D); 14, leg 2 (G).

Male.—Slightly larger than the female. Body length 2.06 mm (1.92–2.27 mm), width 0.77 mm (0.70–0.84 mm), based on 10 specimens. Anterior part of the body, including the fifth pedigerous segment, shorter in relation to the posterior part (Fig. 18). Genital segment (Fig. 19) wider than long, 252 x 370 μ, with the sixth legs located on the posterior corners. Spermatophores (Fig. 20) oval, 112 x 92 μ, with a short neck. Abdomen (Fig. 19) 4-segmented, the segments 215, 201, 154, and 100 μ long respectively. Caudal ramus as in the female.

First antenna, second antenna, mandible, paragnath, and first maxilla like those of the female. Labrum (Fig. 21) with its posterior edge toothed as in the figure. Labium (Fig. 22) with a few blunt teeth on its anterior border and an irregular transverse row of spinules posteriorly. Region between the labrum and the labium similar to that in the female. Second maxilla (Fig. 23) with the stout inner spine on the second podomere of the female here replaced by a strongly sclerotized, broad hook lacking an articulation with the podomere. Outermost spine with its lateral spinules more conspicuous than in the female. Maxilliped (Fig. 24) with a single seta on the first podomere, the second podomere large with its inner side inflated and bearing rows of spinules and 2 setae, the third podomere very short and unarmed, and the last podomere consisting of a slender recurved claw 257 μ long bearing near its inner base a slender setiform process (perhaps homologous to the innermost spine in the female maxilliped), a seta, and a very small spinule, as shown in the figure.

All swimming legs like those of the female, except for the absence of the inner basipodite spine on leg 1.

Leg 5 (Fig. 25) with the first podomere fused with the thoracic segment and bearing an outer seta 100 μ long and a row of stout spinules. Second podomere elongate rather than oval as in the female, 243 x 100 μ, the three spines and the seta being 67, 84, 98, and 81 μ in length, respectively, from outer to inner. Outer edge of the podomere near the articulations of the outer two spines prolonged to form spinelike processes. Other armature as in the figure.

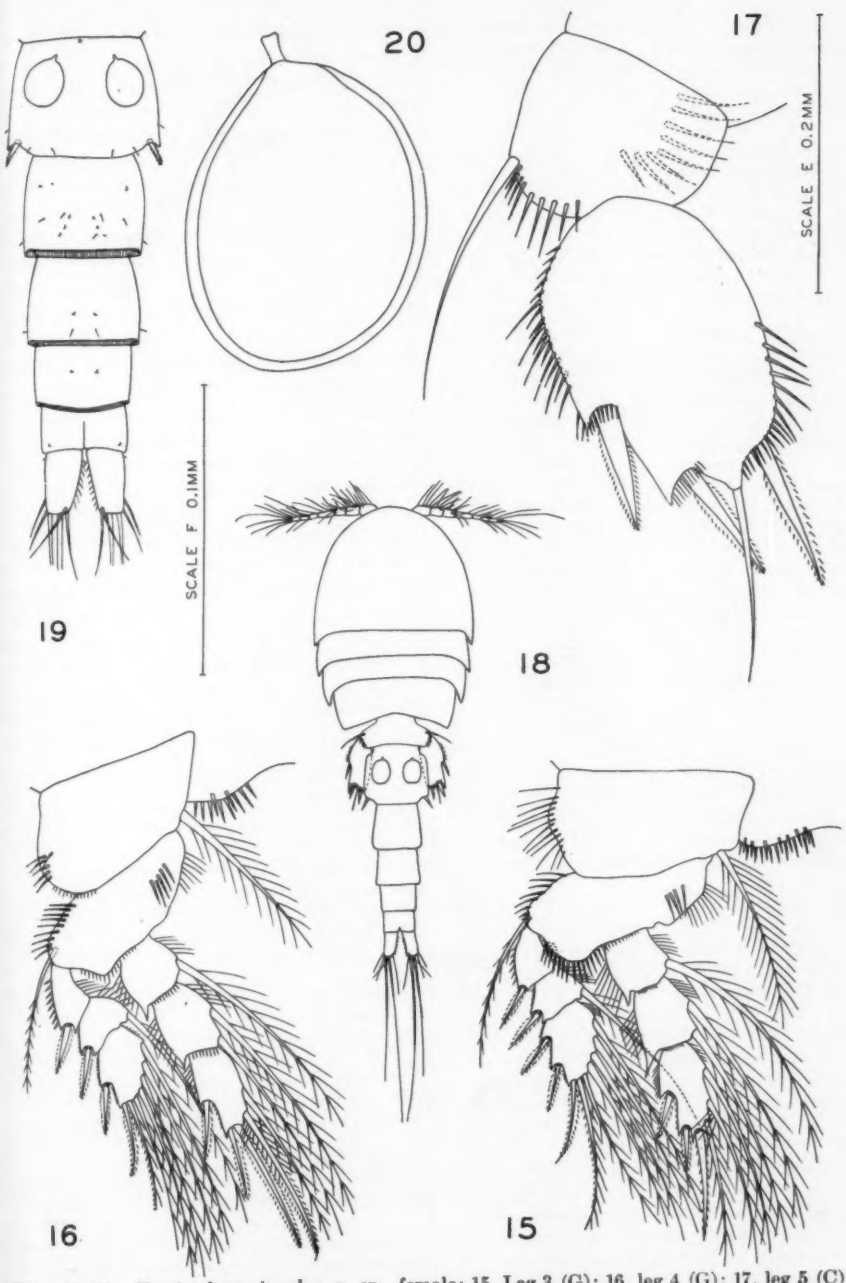
Leg 6 (Fig. 26) a strong spine 68 μ long. Color similar to that of the female.

(The specific name is derived from *visendus*, worth seeing.)

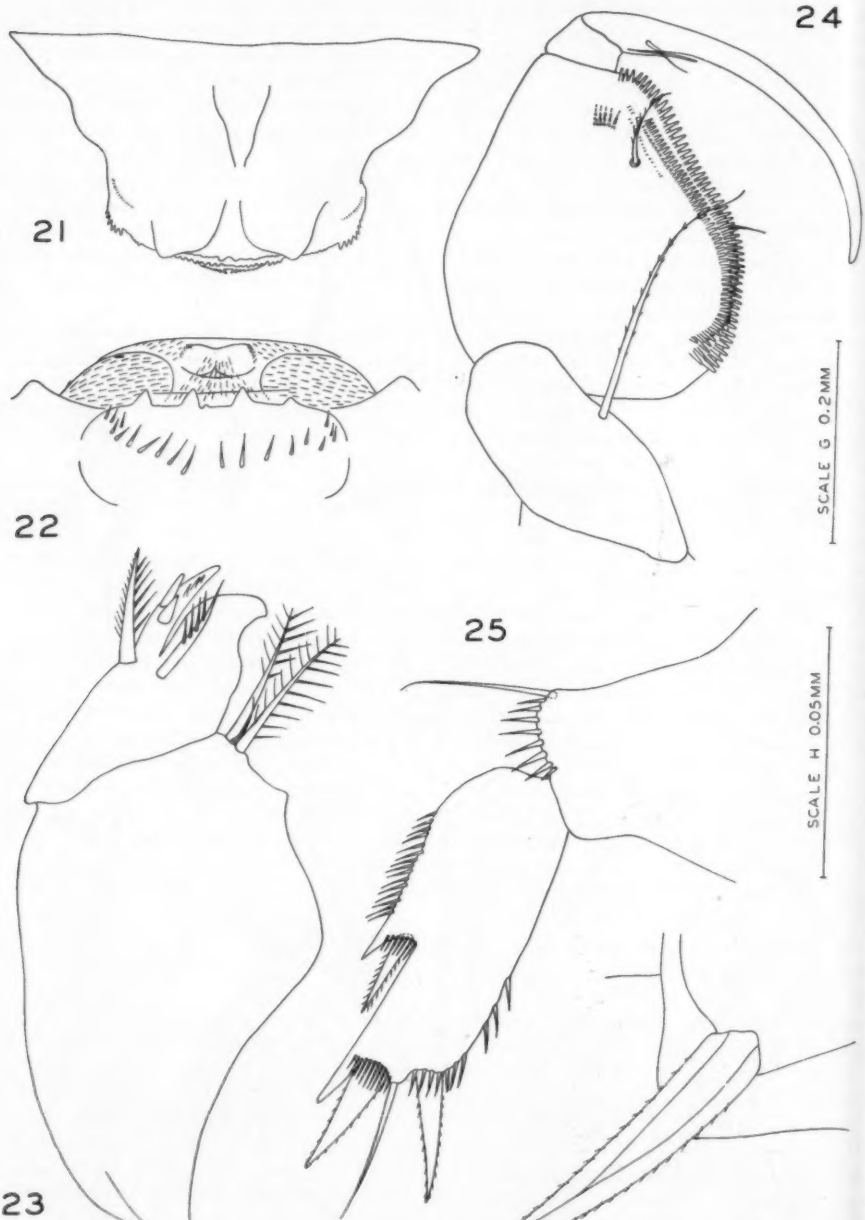
Remarks.—Hemicyclops visendus Humes, Cressey, and Gooding may be distinguished from other species in the genus chiefly by the form of the second podomere of the fifth legs, the length of the caudal rami, and the shape of the third and fourth podomeres of the second antenna. In *H. purpureus* Boeck, 1873, the inner distal angle of the third podomere of the second antenna is not produced and the form of the second podomere of the fifth leg of the female is less distinctly oval (as shown in the figures of Sars, 1917). In *H. adhaerens* (Williams, 1907) and in two new species to be described by Gooding (in press), one from the body surface and burrows of *Arenicola*, the other from washings and burrows of *Callianassa*, the last podomere of the second antenna is more than 2 times longer than wide and the second podomere of the fifth leg of the female is elongate (more than 2 times longer than wide). *H. elongatus* Wilson, 1937, has an elongate second podomere in the fifth leg of the female and the caudal ramus is at least 4 times longer than wide. In *H. thysanotus* Wilson, 1935, the second podomere of the fifth leg is much elongated and the caudal ramus is more than 3½ times longer than wide.

Following the work of Gooding (in press), *H. callianassae* Wilson, 1935, and *H. pugettensis* Light and Hartman, 1937, are considered as synonyms of *H. thysanotus* Wilson, 1935, and *H. americanus* Wilson, 1932, is a synonym of *H. adhaerens* (Williams, 1907). Having examined specimens of *H. littoralis* (T. Scott, 1892), we support Sars's synonymy of this species with *H. purpureus* Boeck, 1873. These four species therefore need not be compared here. *Hersiliodes livingstoni* T. Scott, 1894, doubtfully attributed to *Hemicyclops* by Bocquet and Stock (1957) appears to us to belong to *Hersiliodes* rather than to Boeck's genus.

In *H. indicus* Sewell, 1949, *H. australis* Nicholls, 1944, *H. leggii* (Thompson and Scott, 1903), and *H. tamilensis* (Thompson and Scott, 1903) the caudal ramus is subquadrate, about as long as wide. Both *leggii* and *australis* have 2 setae (instead of one as in *visendus*) on the first podomere of the male maxilliped and *indicus* lacks the projection of the third podomere of the second antenna. In *H. aberdonensis* (T. Scott and A. Scott, 1892) the caudal



FIGS. 15–17.—*Hemicyclops visendus*, n. sp., female: 15, Leg 3 (G); 16, leg 4 (G); 17, leg 5 (C).
FIGS. 18–20.—Same, male: 18, Dorsal view (A); 19, genital segment and abdomen, dorsal (B); 20, spermatophore (F).



FIGS. 21–26.—*Hemicyclops visendus*, n. sp., male: 21, Labrum, ventral (C); 22, labium and adjacent oral region (without paragnaths), ventral (C); 23, second maxilla (C); 24, maxilliped (E); 25, leg 5 (E); 26, leg 6, ventral (H).

ramus is about 3 times longer than wide, there are 2 setae on the first podomere of the male maxilliped, and the third and fourth podomeres of the second antenna are of about equal length and short. In *H. thompsoni* (Canu, 1888) the second podomere of the fifth leg of the female is somewhat elongate, the caudal ramus is about 2½ times longer than wide, and the second podomere of the second antenna bears a marginal row of spinules. *H. canuensis* Bourne, 1890, is, as suggested by Canu (1892, p. 254), probably a synonym of *thompsoni*, and need not be considered here.

In *H. bâcescui* (Şerban, 1956) Stock, in press, the second podomere of the fifth leg of the female is 2.27 times longer than wide and the caudal ramus is about 2 times longer than wide. In *H. dilatatus* Shen and Bai, 1956, no oviducal openings or egg sacs were described on the single specimen known. There may, therefore, be some question whether the specimen is a mature female or a late copepodid. Assuming it to be mature, it differs from *visendus* in that the caudal ramus is shorter than the anal segment, the genital segment is subquadrate, the inner basipodite spine on leg 1 is long (about as long as the first 2 endopodite podomeres together), and the second podomere of leg 5 is elongate rather than oval.

LITERATURE CITED

Bocquet, C., and Stock, J. H. *Copépodes parasites d'invertébrés des côtes de France. I. Sur deux genres de la famille des Clausidiidae, commensaux de mollusques*: Hersiliodes *Canu et* Conchyliurus *nov. gen.* Proc. Akad. Wetensch. Amsterdam, ser.C, **60**: 212–222. 1957.

Boeck, A. *Nye Slaegter og Arter af Saltvands-Copepoder.* Forh. Vidensk. Selsk. 1872: 35–60. 1873.

Bourne, G. C. *Report on the surface collections made by Mr. W. T. Grenfell in the North Sea and west of Scotland.* Journ. Marine Biol. Assoc. United Kingdom **1**(n.s.): 376–381. 1890.

Canu, E. *Les copépodes marins du Boulonnais. III. Les Hersiliidae, famille nouvelle de copépodes commensaux.* Bull. Sci. France et Belgique **19**: 402–432. 1888.

———. *Les copépodes du Boulonnais. Morphologie, embryologie, taxonomie.* Trav. Lab. Zool. Maritime Wimereux-Ambleteuse **6**: 1–354. 1892.

Gooding, R. U. *North and South American copepods belonging to the genus* Hemicyclops. Proc. U. S. Nat. Mus. (in press).

Light, S. F., and Hartman, O. *A review of the genera* Clausidium *Kossmann and* Hemicyclops *Boeck (Copepoda, Cyclopoida) with the description of a new species from the northeast Pacific.* Univ. California Publ. Zool. **41**: 173–188. 1937.

Nicholls, A. G. *Littoral Copepoda from South Australia (II) Calanoida, Cyclopoida, Notodelphyoida, Monstrilloida and Caligoida.* Rec. South Austral. Mus. **8**: 1–62. 1944.

Sars, G. O. *An account of the Crustacea of Norway with short descriptions and figures of all the species. VI. Copepoda Cyclopoida, parts XI and XII Clausidiidae, Lichomolgidae (part)*: 141–172. 1917.

Scott, T. *Additions to the fauna of the Firth of Forth. Part IV.* 10th Ann. Rep. Fish. Board Scotland, pt. 3: 244–272. 1892.

———. *Report on Entomostraca from the Gulf of Guinea, collected by John Rattray, B. Sc.* Trans. Linn. Soc. London, ser. 2, Zool., **6**: 1–161. 1894.

Scott, T., and Scott, A. *On new and rare Crustacea from the east coast of Scotland.* Ann. Scottish Nat. Hist. 1892: 149–156. 1892.

Şerban, M. Pontocyclops bâcescui *n. g., n. sp. (Crustacea Copepoda), ein neuer Cyclopide vom schwarzen Meere.* Izdanija (ЗАВОД ЗА РИБАРСТВО НА НР МАКЕДОНИЛА) **1**: 169–184. 1956.

Sewell, R. B. S. *The littoral and semi-parasitic Cyclopoida, the Monstrilloida and Notodelphoida.* John Murray Exped. 1933–34, Sci. Reps. **9**: 17–199. 1949.

Shen, C. J., and Bai, S. O. *The marine Copepoda from the spawning ground of* Pneumatophorus japonicus *(Houttuyn) off Chefoo, China.* Acta Zool. Sinica **8**: 177–234. 1956.

Stock, J. H. *Copepods associated with Neapolitan invertebrates.* Pubbl. Staz. Zool. Napoli (in press).

Thompson, I. C., and Scott, A. *Report on the Copepoda collected by Professor Herdman, at Ceylon, in 1902.* Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar. Supplementary Rep. no. 7: 227–307. London, 1903.

Williams, L. W. *List of the Rhode Island Copepoda, Phyllopoda, and Ostracoda with new species of Copepoda.* 37th Ann. Rep. Commissioners of Inland Fisheries of Rhode Island, special paper no. 30: 69–79. 1907.

Wilson, C. B. *The copepod crustaceans of Chesapeake Bay.* Proc. U. S. Nat. Mus. **80**: 1–54. 1932.

———. *Parasitic copepods from the Pacific coast.* Amer. Midl. Nat. **16**: 776–791. 1935.

———. *Two new semi-parasitic copepods from the Peruvian coast.* Parasitology **29**: 206–211. 1937.

AUTOMATIC READER FOR HIGH-PRECISION BALANCES

The National Bureau of Standards has developed a photoelectric device that automatically and continuously indicates the position of the swinging beam of a high-precision balance. At the same time it provides a greatly increased reading sensitivity, the minimum readable displacement on the scale being 0.0001 inch as compared with 0.004 inch for the conventional visual method.

Design and construction of the apparatus are due primarily to L. B. Macurdy and H. A. Bowman. Consultation was provided by M. L. Greenough and T. R. Young, also of the Bureau staff; and the instrument was fabricated largely in the Bureau's instrument shop.

PRIMARILY A RESEARCH TOOL

The device was developed primarily as a research tool for obtaining a better understanding of balance errors; data from such studies are now being accumulated and will be used in working out improved balance designs. The photoelectric reader can provide data on the motion of the balance beam (i.e., of the horizontal arm from which the balance pans are suspended) in two forms: (1) As a voltage whose magnitude represents the instantaneous position of the beam; or (2) as numerical data that represent turning points (extremes of the swing), from which masses may be calculated. A plot of the output voltage on a recorder forms a graph that can be used in evaluating the dynamic characteristics of the oscillating structure. The turning points are read from a dial that ordinarily indicates the instantaneous position of the beam, but which remains stationary for a brief interval after each turning point is reached.

Though primarily a research tool, the photoelectric device also contributes in a more direct way to reduce the errors in precision mass measurements. Major errors in such measurements are due to small changes in temperature and humidity that occur during the course of the experiment. Since the automatic reader makes it possible to increase the speed of balance operations by from 5 to 10 times, it shortens the interval during which these changes in ambient conditions can act. Faster operation also increases the "on scale" range of the balance; and this permits the use of larger—and hence more accurate—sensitivity weights. The disadvantage of high-speed operation is that it ordinarily results in losses of readability and deflection sensitivity. However, the high reading sensitivity of the present instrument more than compensates for these losses.

BASIC DESIGN OF READER

The basic design of the reader is fairly straightforward. A narrow beam of light is sent towards the balance and is reflected by a mirror on the balance beam back to the slit at the front of a photocell. Besides swinging with the motion of the balance, the light beam has a small 60-c/s vibration of its own (amplitude about 1 minute of arc). This facilitates the design of a servo loop to maintain the photocell slit centered on the light beam. When light beam and slit are not in line, an "error signal" is generated, and this controls a two-phase motor that turns the lead screw on which the photocell is mounted. By suitable design and adjustment of the components, the photocell is made to follow the swinging light beam to within about 0.0002 inch, corresponding to 4×10^{-5} degree in the angular position of the balance arm.

The position of the balance beam is thus represented by the angle turned through by the lead screw. The latter drives a dial which has a single turn of free play so that when the direction of the lead screw reverses (i.e., at a turning point) the dial remains motionless for one revolution of the screw. To obtain a voltage proportional to the position of the balance beam, the lead screw is mechanically coupled to the pick-off arm of a precision potentiometer.

BACKGROUND NOISE

Zero stability of the apparatus, determined from observations on a light beam reflected from an arrested (and therefore presumably motionless) balance, is about 2 microinches per minute. This drift changes direction roughly twice daily, and may therefore be associated with some diurnal motion of the building or piers. There are occasional bursts of "noise" of about ±0.0003 inch, some of which have been correlated with starting and stopping of building ele-

vators. However, the total effect of all noise is not considered serious enough to warrant additional noise studies at this time.

The reader is currently being used to evaluate mechanical features that are under consideration for inclusion in a short-period high-precision automatic weighing system for which preliminary studies are under way. Already a number of useful results have been obtained. In one study, for example, the device has been used to show the effects of errors associated with a certain type of arrestment mechanism, while another has shown the reloading error in a balance of one design when operated without arrestment.

Taisia Maximovna Stadnichenko

Taisia Maximovna Stadnichenko, of the U. S. Geological Survey, died on November 26, 1958, after a short heart ailment. Miss Stadnichenko was born in Taganash, Crimea, Russia, on October 9, 1894, and was graduated from the Vladivostok Gymnasium in 1912 and from the University of Petrograd in 1917. She began her scientific career in 1917 as a chemist with the Russian Geological Survey expedition to the Island of Sakhalin, off the east coast of Siberia.

She came to the United States after World War I as an interpreter for the Russian Peace Mission and a representative to the Washington Disarmament Conference. For three years—1922–1925—she was an instructor in chemistry at Vassar College, and throughout her career she never lost her enthusiasm for helping young scientists along their professional way. From 1925 to 1931 she was a research assistant of the National Research Council and American Petroleum Institute.

In 1931 Miss Stadnichenko became a naturalized citizen and at that time joined the staff of the U. S. Geological Survey to carry on research relating to the origin and constitution of coal and carbonaceous shales in association with the late Dr. David White. In this study she achieved a position as one of the foremost investigators of the geochemistry of coal. During and soon after World War II Miss Stadnichenko's work was directed toward the recovery of germanium from coal ash, a minor element that was of tremendous importance at that time in the manufacture of transistors. The results of this investigation were published in U. S. Geological Survey Circular 272. At the time of her death she was in charge of an investigation of the distribution of minor elements in American coals; manuscripts on beryllium and molybdenum content of American coals and on the geochemistry of minor elements of the coals of the Northern Great Plains, written in collaboration with Peter Zubovic and N. B. Sheffey, are awaiting publication.

ANNA JESPERSEN

Ralph B. Stewart

Ralph B. Stewart died suddenly on November 29, 1958, at the age of 57 years.

Born June 29, 1901, in Pennsylvania, he attended the University of Washington (B.S., 1923), the University of California (graduate work, 1924–26), and the Johns Hopkins University (Ph.D., 1928). With the exception of brief tours of teaching at Bryn Mawr College and Stanford University, he spent his professional life on the U. S. Geological Survey as geologist and paleontologist, much of it in the Washington area.

While he was still a graduate student, he wrote two monumental memoirs, published in 1927 and 1930, on California Cretaceous and Tertiary mollusks. He was especially interested in early Tertiary mollusks. He quickly mastered, however, any field in which he became interested, as shown by his penetrating observations and analysis of the fault pattern in the North Dome of the Kettleman Hills (one of California's major oilfields), published in 1941. His career was later shadowed by progressively declining health. He is survived by his wife, Irene Stewart, of New Haven, Conn.

INDEX TO VOLUME 48

An asterisk (*) denotes the abstract of a paper presented before the Academy or an affiliated society

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

Geological Society of Washington. 132.

Washington Academy of Sciences. 332.

AUTHOR INDEX

ADLER, ISIDORE. * Some applications of X-ray fluorescent spectroscopy to mineralogical problems. 135.

ALLARD, HOWARD F., and ALLARD, HARRY A. Venomous moths and butterflies. 18.

ALSTON, A. H. G. New or noteworthy ferns from Colombia and Ecuador. 230.

ANDREASEN, G. E., and ZIETZ, ISIDORE. * Limiting parameters in the magnetic interpretation of a geologic structure. 135.

BAILEY, L. F. See CARDER, D. S. 143.

BALL, DOUGLAS, and WINER, A. S. * Brandywine Structure, and underground natural gas storage for Washington, D. C. 133.

BARNES, HARLEY. * Geology of a Philippine coal field. 138.

BASTRON, HARRY. See ROBINSON, W. O. 140.

BATEMAN, P. C. * Characteristics of some eastern Sierra Nevada granites. 132.

BATES, R. G. See GUILLOU, R. B. 139.

BAYER, FREDERICK M. Further remarks on the geographical distribution of Gorgoniidae. 394.

BLAKE, S. F. Two species of *Hibiscus* from Texas. 277.

BRIDGERS, BERNARD T. Techniques involving the sowing of spores of the Filicinae for artificial culture. 158.

BRÖNNIMANN, PAUL, and BROWN, NOEL K., JR. *Hedbergella*, a new name for a Cretaceous planktonic foraminiferal genus. 15.

BROWN, NOEL K., JR. See BRÖNNIMANN, PAUL. 15.

BROWN, ROLAND W. New occurrences of the fossil quillworts called Isoetites. 358.

BURKS, B. D. A recharacterization of the genus *Coelopencyrtus*, with descriptions of two new species (Hymenoptera: Encyrtidae). 22.

CAMPAIGNE, HOWARD. A new characterization of group. 276.

CARDER, D. S., and BAILEY, L. F. * Seismic wave travel times from nuclear explosions. 143.

CASH, EDITH K. Some new or rare Discomycetes from South America. 256.

CHAPMAN, HAROLD C. See DRAKE, CARL J. 317.

CRABILL, RALPH E., JR. A new *Eulithobius*, with a key to the known American species (Chilopoda: Lithobiidae). 260.

CRESSEY, ROGER F. See HUMES, ARTHUR G. 398.

CRIST, RAYMOND E. Pile-dwellers and coconut culture in the Laguna de Sinamaica, Venezuela. 380.

DICKE, R. H. Gravitation an enigma. 213.

DOUGLASS, R. C. * Significance and distribution of *Orbitolina*. 136.

DRAKE, CARL J., and CHAPMAN, HAROLD C. Neotropical Hebridae, including a catalogue of the American species (Hemiptera). 317.

FRIEDMAN, IRVING, and SMITH, R. L. * The origin of water in some volcanic glasses. 139.

GOODING, RICHARD U. See HUMES, ARTHUR G. 398.

GREENSTONE, REYNOLD. Temperatures in heated finite slabs with fourth-power loss. 341.

GUILLOU, R. B., and BATES, R. G. * The correlation of airborne radioactivity data and aerial geology. 139.

HARDY, JERRY D., JR. A new lizard of the genus *Leiocephalus* from Cuba (Squamata: Iguanidae). 294.

HARTMAN, OLGA. A new nereid worm from Warm Mineral Springs, Fla., with a review of the genus *Nicon* Kinberg. 263.

HASS, W. H. * Classification and stratigraphic range of disjunct conodonts. 141.

HESS, W. C., and SHAFFRAN, I. P. Inhibition by testosterone of cortisone-induced liver glycogen formation. 347.

———. The effect of cortisone on the incorporation of C-14 in various tissues from 2-C-14 labeled alanine. 109.

HOBBS, HORTON H., JR. Two new crayfishes of the genus *Procambarus* from South Carolina. 160.

HOFFMAN, RICHARD L. Appalachian Cambalidae: Taxonomy and distribution (Diplopoda: Spirostreptida). 90.

HOLDER, PRESTON, and STEWART, T. D. A complete find of filed teeth from the Cahokia Mounds in Illinois. 349.

HUMES, ARTHUR G. *Antillesia cardisomae*, n. gen. and sp. (Copepoda: Harpacticoida) from the gill chambers of land crabs, with observations on the related genus *Cancrinola*. 77.

HUMES, ARTHUR G., CRESSEY, ROGER F., and GOODING, RICHARD U. A new cyclopoid copepod, *Hemicyclops visendus*, associated with *Upogebia* in Madagascar. 398.

HUNTER, MATTHEW A. Progress in titanium research. 1.

IWAI, TAMOTSU. A study of the luminous organ of the apogonid fish *Siphamia versicolor* (Smith and Radcliffe). 267.

JACKSON, JULIUS L. Stabilized free radicals. 181.

JONES, MEREDITH L. Further notes on *Sarsiella tricostata*. 238.

———. *Sarsiella tricostata*, a new ostracod from San Francisco Bay (Myodocopa: Cypridinidae). 48.

KENG, Y. L. Two new genera of grasses from China. 115.

KIMBALL, GEORGE E. A critique of operations research. 33.

KINKEL, A. R. * Copper deposits of the Philippines. 138.

KOCH, LEO FRANCIS. On scientist and theologian? 252.

LOOMIS, H. F. A new family of millipeds on Barro Colorado Island, Canal Zone. 235.

MANNING, RAYMOND B. See ROBINS, C. RICHARD. 301.

MEAD, GILES W. A new species of iniomous fish from the Gulf of Mexico. 188.

———. Three new species of archibenthic iniomous fishes from the western North Atlantic. 362.

MEYERHOFF, H. A. * Evolution of Appalachian drainage: a reinterpretation from geologic evidence. 134.

MOORE, WALTER G. On the occurrence of *Streptocephalus similis* Baird in Mexico and the United States. 169.
MURATA, K. J. See ROBINSON, W. O. 140.
NACE, R. L. * Hydrology of the Snake River basalt. 136.
NICOL, DAVID. A survey of inequivalve pelecypods. 56.
———. Notes on prionodont pelecypods. 309.
———. Taxonomy versus stratigraphy. 113.
———. The pelecypod *Euloxa*: Observations on new localities. 153.
———. Trends and problems in pelecypod classification (the genus and subgenus). 285.
OLIVER, H. W. * Testing isostasy in California. 141.
PERLOWAGORA-SZUMLEWICZ, ALINA, and VON BRAND, THEODOR. Observations on the oxygen consumption of young *Australorbis glabratus*. 38.
PIERCE, W. G. * Detachment thrusts, with special reference to the Heart Mountain thrust, Wyoming. 142.
PITTENDRIGH, COLIN S. A new bromeliad from the Northern Range in Trinidad. 315.
RANDALL, JOHN E. Two new species of *Anampses* from the Hawaiian Islands, with notes on other labrid fishes of this genus. 100.
REED, CLYDE F. Contributions to the herpetology of Maryland and Delmarva, No. 17: Southeastern herptiles with northern limits on coastal Maryland, Delmarva, and New Jersey. 28.
———. Contributions to the herpetology of Maryland and Delmarva, 13: Piedmont herpetofauna on coastal Delmarva. 95.
REISH, DONALD J. Description of a new species of *Cossura* (Annelida: Polychaeta) from the Mississippi Delta. 53.
ROBERTS, ELLIOTT B. Ferdinand Hassler's gift to America. 69.
ROBERTSON, E. C. * Experimental consolidation of aragonite mud. 142.
ROBINS, C. RICHARD. *Garmannia zebrella*, a new gobiid fish from Trinidad, with notes on the species of the subgenus *Tigrigobius* Fowler. 192.
ROBINS, C. RICHARD, and MANNING, RAYMOND B. The status and distribution of the fishes of the family Microdesmidae in the Western Atlantic. 301.
ROBINSON, W. O., BASTRON, HARRY, and MURATA, K. J. * Biogeochemistry of the rare earth elements with special reference to the hickory tree. 140.
RUBIN, MEYER. * New treatment and resulting C-14 dates from the Near East. 143.
———. * Radiocarbon age determination of a Pleistocene section near Scranton, Iowa. 134.
SCHRACK, ROALD A. The electrostatic field and the symmetry of snowflakes. 273.
SCHWARTZ, ALBERT. Another new species of *Eleutherodactylus* (Amphibia: Leptodactylidae) from western Cuba. 127.
SEEGER, RAYMOND J. Scientist and theologian? 145.
SETTY, L. R. The cutaneous muscles of the Adelie penguin (*Pygosceles adeliae*). 387.
SHAFFRAN, I. P. See HESS, I. C. 109, 347.
SMITH, LYMAN B. Notes on South American phanerogams—I. 282.
———. Notes on South American phanerogams—II. 310.
SMITH, R. L. See FRIEDMAN, IRVING. 139.
STASEK, CHARLES R. A new species of *Allogauasia* (Amphipoda, Lyianassidae) found living within the gastrovascular cavity of the sea-anemone *Anthopleura elegantissima*. 119.
STEWART, D. B. * Some feldspar problems. 135.
STEWART, T. D. See HOLDER, PRESTON. 349.
STILL, JOSEPH W. Our scientific "nervous system." 373.
———. The physiology of aging—a research approach. 224.
STONE, ALAN, and THURMAN, ERNESTINE B. *Armigeres* (*Armigeres*) *baisasi*, a new mosquito from the Philippine Islands (Diptera: Culicidae). 240.
TAUSSKY, OLGA. A note on the group commutator of A and A*. 305.
THAYER, T. P. * Some relations of later Tertiary volcanology and structure in eastern Oregon. 133.
THOMPSON, R. C. On matrix commutators. 306.
THURMAN, DEED C., JR., and THURMAN, ERNESTINE B. Two new species in the genus *Armigeres* Theobald, 1901, from northern Thailand (Diptera: Culicidae). 186.
THURMAN, ERNESTINE B. Revalidation of three species of *Armigeres* Theobald, 1901 (Diptera: Culicidae). 389.
———. See also THURMAN, DEED C., JR. 186. See also STONE, ALAN. 240.
TILTON, G. R. * Are tektites out of this world? 140.
TODD, E. L. A new species of *Meropleon* Dyar from South Carolina (Lepidoptera: Noctuidae). 27.
VALLENTYNE, J. R. * Paleobiochemistry. 134.
VAUGHN, PETER PAUL. A pelycosaur with subsphenoidal teeth from the lower Permian of Oklahoma. 44.
VON BRAND, THEODOR. See PERLOWAGORA-SZUMLEWICZ, ALINA. 38.
WINER, A. S. See BALL, DOUGLAS. 133.
YOCHELSON, ELLIS L. Some Lower Ordovician monoplacophoran mollusks from Missouri. 8.
———. * The Lower Ordovician gastropod *Ceratopea*. 139.
ZIETZ, ISIDORE. See ANDREASEN, G. E. 135.

Anthropology. A complete find of filed teeth from the Cahokia Mounds in Illinois. PRESTON HOLDER and T. D. STEWART. 349.

Biochemistry. Inhibition by testosterone of cortisone-induced liver glycogen formation. W. C. HESS and I. P. SHAFFRAN. 347.

The effect of cortisone on the incorporation of C-14 in various tissues from 2-C-14 labeled alanine. W. C. HESS and I. P. SHAFFRAN. 109.

Biogeochemistry. * Biogeochemistry of the rare earth elements with special reference to the hickory tree. W. O. ROBINSON, HARRY BASTRON, and K. J. MURATA. 140.

* Paleobiochemistry. J. R. VALLENTYNE. 134.

Botany. A new bromeliad from the Northern Range in Trinidad. COLIN S. PITTENDRIGH. 315.

New or noteworthy ferns from Colombia and Ecuador. A. H. G. ALSTON. 230.

Notes on South American phanerogams—I. LYMAN B. SMITH. 282.

Notes on South American phanerogams—II. LYMAN B. SMITH. 310.

Techniques involving the sowing of spores of the Filicinae for artificial culture. BERNARD T. BRIDGERS. 158.

Two new genera of grasses from China. Y. L. KENG. 115.

Two species of *Hibiscus* from Texas. S. F. BLAKE. 277.

Entomology. A new species of *Meropleon* Dyar from South Carolina (Lepidoptera: Noctuidae). E. L. TODD. 27.

Armigeres (*Armigeres*) *baisasi*, a new mosquito from the Philippine Islands (Diptera: Culicidae). ALAN STONE and ERNESTINE B. THURMAN. 240.

A recharacterization of the genus *Coelopencyrtus*, with descriptions of two new species (Hymenoptera: Encyrtidae). B. D. BURKS. 22.

New Neotropical Hebridae, including a catalogue of the American species (Hemiptera). CARL J. DRAKE and HAROLD C. CHAPMAN. 317.

Revalidation of three species of *Armigeres* Theobald, 1901 (Diptera: Culicidae). ERNESTINE B. THURMAN. 389.

Two new species in the genus *Armigeres* Theobald, 1901, from northern Thailand (Diptera: Culicidae). DEED C. THURMAN, JR., and ERNESTINE B. THURMAN. 186.

Venomous moths and butterflies. HOWARD F. ALLARD and HARRY A. ALLARD. 18.

Ethnogeography. Pile-dwellers and coconut culture in the Laguna de Sinamaica, Venezuela. RAYMOND E. CRIST. 380.

General science. A critique of operations research. GEORGE E. KIMBALL. 33.

Our scientific "nervous system." JOSEPH W. STILL. 373.

Geochemistry. * Are tektites out of this world? G. R. TILTON. 140.

Geology. * Brandywine Structure, and underground natural gas storage for Washington, D. C. DOUGLAS BALL and A. S. WINER. 133.

* Characteristics of some eastern Sierra Nevada granites. P. C. BATEMAN. 132.

* Copper deposits of the Philippines. A. R. KINKEL. 138.

* Detachment thrusts, with special reference to the Heart Mountain thrust, Wyoming. W. G. PIERCE. 142.

* Evolution of Appalachian drainage: a reinterpretation from geologic evidence. H. A. MEYERHOFF. 134.

* Experimental consolidation of aragonite mud. E. C. ROBERTSON. 142.

* Geology of a Philippine coal field. HARLEY BARNES. 138.

* Hydrology of the Snake River basalt. R. L. NACE. 136.

* Limiting parameters in the magnetic interpretation of a geologic structure. G. E. ANDREASEN and ISIDORE ZIETZ. 135.

* New treatment and resulting C-14 dates from the Near East. MEYER RUBIN. 143.

* Radiocarbon age determination of a Pleistocene section near Scranton, Iowa. MEYER RUBIN. 134.

* Some feldspar problems. D. B. STEWART. 135.

* Some relations of later Tertiary volcanology and structure in eastern Oregon. T. P. THAYER. 133.

Taxonomy versus stratigraphy. DAVID NICOL. 113.

* The correlation of airborne radioactivity data and aerial geology. R. B. GUILLOU and R. G. BATES. 139.

* The origin of water in some volcanic glasses. IRVING FRIEDMAN and R. L. SMITH. 139.

Geophysics. * Seismic wave travel times from nuclear explosions. D. S. CARDER and L. F. BAILEY. 143.

* Testing isostasy in California. H. W. OLIVER. 141.

Herpetology. A new lizard of the genus *Leiocephalus* from Cuba (Squamata: Iguanidae). JERRY D. HARDY, JR. 294.

Another new species of *Eleutherodactylus* (Amphibia: Leptodactylidae) from western Cuba. ALBERT SCHWARTZ. 127.

Contributions to the herpetology of Maryland and Delmarva, 13: Piedmont herpetofauna on coastal Delmarva. CLYDE F. REED. 95.

Contributions to the herpetology of Maryland and Delmarva, No. 17: Southeastern herptiles with northern limits on coastal Maryland, Delmarva, and New Jersey. CLYDE F. REED. 28.

History of science. Ferdinand Hassler's gift to America. ELLIOTT B. ROBERTS. 69.

Ichthyology. A new species of iniomous fish from the Gulf of Mexico. GILES W. MEAD. 188.

A study of the luminous organ of the apogonid fish *Siphamia versicolor* (Smith and Radcliffe). TAMOTSU IWAI. 267.

Garmannia zebrella, a new gobiid fish from Trinidad, with notes on the species of the subgenus *Tigrigobius* Fowler. C. RICHARD ROBINS. 192.

The status and distribution of the fishes of the family Microdesmidae in the Western Atlantic. C. RICHARD ROBINS and RAYMOND B. MANNING. 301.

Two new species of *Anampses* from the Hawaiian Islands, with notes on other labrid fishes of this genus. JOHN E. RANDALL. 100.

Three new species of archibenthic iniomous fishes from the western North Atlantic. GILES W. MEAD. 362.

Mathematics. A new characterization of group. HOWARD CAMPAIGNE. 276.
A note on the group commutator of A and A*. OLGA TAUSSKY. 305.
On matrix commutators. R. C. THOMPSON. 306.
Mineralogy. * Some applications of X-ray fluorescent spectroscopy to mineralogical problems. ISIDORE ADLER. 135.
Progress in titanium research. MATTHEW A. HUNTER. 1.
Mycology. Some new or rare Discomycetes from South America. EDITH K. CASH. 256.
New members (1955, 1956). 326.
Notes and news. Post-shot yield measurement of AEC underground nuclear test, 14; Study of frogfishes, 26; Shanidar skull, 37; Activities of the Joint Board on Science Education, 63; Science curricula in secondary schools, 66; Interaction of direct azo dyes in aqueous solution, 75; Cockroaches and disease, 108; *Eremotherium*, the giant sloth, 144; Retardation of copper corrosion by light, 157; Surface attack by buffer solutions, 159; Martian atmosphere restudied, 176; Air pollution studies, 179; Cryostat for precise temperature control over very wide range, 180; River Basin Surveys unearth big Plains Indian town, 198; Automatic sorting machine for letter mail, 199; Color response of the human eye, 201; Problem solving on the high-speed computer, 204; Processing pictorial information on digital computers, 210; High-temperature transformations, 244; Studies of electroless plating, 247; Academy opens headquarters office, 249; Life history of meadowlark, 250; Worm behavior, 255; Energy distributions and temperature determinations in flames; 271; Gyromagnetic ratio of proton redetermined, 280; Araucanian witchcraft, 293; Determination of acetylene in low concentrations for air-pollution control, 307; Recent honors, new appointments, 348; Jungle camouflage, 386; Hitch-hikers of the sea, 396; Voices of the stars, 397; Automatic reader for high-precision balances, 406.
Obituaries. Milton Abramowitz, 266; Taisia Maximovna Stadnichenko, 407; Ralph B. Stewart, 408.
Paleobotany. New occurrences of the fossil quillworts called Isoetites. ROLAND W. BROWN. 358.
Paleontology. A pelycosaur with subsphenoidal teeth from the lower Permian of Oklahoma. PETER PAUL VAUGHN. 44.
* Classification and stratigraphic range of disjunct conodonts. W. H. HASS. 141.
Hedbergella, a new name for a Cretaceous planktonic foraminiferal genus. PAUL BRÖNNIMANN and NOEL K. BROWN, JR. 15.
Notes on prionodont pelecypods. DAVID NICOL. 309.
* Significance and distribution of *Orbitolina*. R. C. DOUGLASS. 136.
Some Lower Ordovician monoplacophoran mollusks from Missouri. ELLIS L. YOCHELSON. 8.
* The Lower Ordovician gastropod *Ceratopea*. ELLIS L. YOCHELSON. 139.
The pelecypod *Euloxa*: Observations on new localities. DAVID NICOL. 153.
Philosophy. On scientist and theologian? LEO FRANCIS KOCH. 252.
Scientist and theologian? RAYMOND J. SEEGER. 145.
Physical chemistry. Stabilized free radicals. JULIUS L. JACKSON. 181.
Physics. Gravitation an enigma. R. H. DICKE. 213.
Temperatures in heated finite slabs with fourth-power loss. REYNOLD GREENSTONE. 341.
The electrostatic field and the symmetry of snowflakes. ROALD A. SCHRACK. 273.
Physiology. Observations on the oxygen consumption of young *Australorbis glabratus*. ALINA PERLOWAGORA-SZUMLEWICZ and THEODOR VON BRAND. 38.
The physiology of aging—a research approach. JOSEPH W. STILL. 224.
Zoology. A new cyclopoid copepod, *Hemicyclops visendus*, associated with *Upogebia* in Madagascar. ARTHUR G. HUMES, ROGER F. CRESSEY, and RICHARD U. GOODING. 398.
A new *Eulithobius*, with a key to the known American species (Chilopoda: Lithobiidae). RALPH E. CRABILL, JR. 260.
A new family of millipeds on Barro Colorado Island, Canal Zone. H. F. LOOMIS. 235.
A new nereid worm from Warm Mineral Springs, Fla., with a review of the genus *Nicon* Kinberg. OLGA HARTMAN. 263.
A new species of *Allogaussia* (Amphipoda, Lysianassidae) found living within the gastrovascular cavity of the sea-anemone *Anthopleura elegantissima*. CHARLES B. STASEK. 119.
Antillesia cardisomae, n. gen. and sp. (Copepoda: Harpacticoida) from the gill chambers of land crabs, with observations on the related genus *Cancrinola*. ARTHUR G. HUMES. 77.
Appalachian Cambalidae: Taxonomy and distribution (Diplopoda: Spirostreptida). RICHARD L. HOFFMAN. 90.
A survey of inequivalve pelecypods. DAVID NICOL. 56.
Description of a new species of *Cossura* (Annelida: Polychaeta) from the Mississippi Delta. DONALD J. REISH. 53.
Further notes on *Sarsiella tricostata*. MEREDITH L. JONES. 238.
Further remarks on the geographical distribution of Gorgoniidae. FREDERICK M. BAYER. 394.
On the occurrence of *Streptocephalus similis* Baird in Mexico and the United States. WALTER G. MOORE. 169.
Sarsiella tricostata, a new ostracod from San Francisco Bay (Myodocopa: Cypridinidae). MEREDITH L. JONES. 48.
The cutaneous muscles of the Adelie penguin (*Pygoscelis adeliae*). L. R. SETTY. 387.
Trends and problems in pelecypod classification (the genus and subgenus). DAVID NICOL. 285.
Two new crayfishes of the genus *Procambarus* from South Carolina. HORTON H. HOBBS, JR. 160.

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